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CORRECTION

Volume 68, June 1946, Page 169, second column, second footnote, the legend "Fig. 1" should be "Fig. 2".

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WIND FORCE AND EXCEPTIONAL VISIBILITY AT SEA

By I. R. TANNEHILL

[Weather Bureau, Washington, October 1939]

Visibility depends upon numerous factors, including many properties of the object used as a visibility mark, and variable conditions of light and atmosphere.[1] Studies of visibility have been made on land, and to some extent on seacoasts, but little has been done for the open sea. Actually, there are seldom in the open sea any marks for estimating visibility beyond small distances in the terms of a ship's length. An international scale [2] is in use on shipboard but it depends largely on rough estimates.

For many years seamen have entered the Beaufort symbol "v" in their meteorological logs to indicate abnormal clearness and transparency of the atmosphere. "With such exceptional visibility distant objects stand out from their background with great distinctness and show more sharply-defined detail than usual."[3] At the other end of the scale, where horizontal visibility at sea is very poor, the obscuration is almost always due to fog, which is carefully recorded. The records of "v" will be discussed here in relation to wind velocity.

It has been the general conclusion that an increase in wind velocity tends to increase the horizontal visual range, by carrying to higher levels the dust particles that tend to accumulate in the lower atmosphere. This definitely applies to land observations except in deserts and other regions where increased wind carries appreciable amounts of fresh dust or sand into the air. In previous studies, some records at coastal stations seemed to indicate that the reverse is true there, that is, the visual range diminishes as the wind velocity increases. For example, Dines and Mulholland,[4] dealing with observations made at Valencia Observatory, on the extreme west coast of Ireland, found it noticeable that exceptionally good visibility denoted by the letter "v" mostly occurred with light winds, and that the stronger winds between south-southeast and southwest had the worst visibility of all.

In the Marine Division of the U. S. Weather Bureau there are now available for study the data compiled from 5½ millions of observations from ships during a period of approximately 50 years.[5] From these compilations we have, by 5° squares, average wind forces converted to knots and the percentage frequency of observations of "v". These values have been computed by months and seasons. Winter includes December, January, and February; spring comprises March, April, and May; etc. Annual values have also been computed.

Taking annual values for all 5° squares of the Pacific Ocean north of the 20th parallel of north latitude, we have available as a basis for study very nearly 700,000 observations. The annual averages of these 5° squares, when assembled to show frequency of exceptional visibility in squares with certain wind velocities, appear in figure 1. Here, for example, the visibility value of 8.8 percent plotted against an average wind velocity of 8 knots (value "A" in figure 1) is determined as follows: All squares with an average annual wind movement of 8 knots are segregated and the average annual frequency of exceptional visibility is determined for all of these squares combined. The same is done for squares with other velocities. The results seem to indicate a definite tendency for the range of visibility to diminish with increase of wind velocity. Values for velocities below 8 knots and above 16 knots are not included as they were too few in number to make a dependable showing.

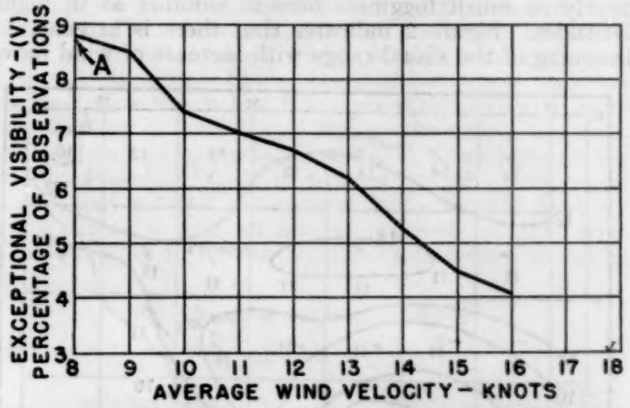


FIGURE 1.—Frequency of exceptional visibility as related to average wind velocity. Data for the North Pacific Ocean; annual values by 5° squares north of 20° N. Frequency of exceptional visibility ("v") is the ratio of observations of "v" to the total number of observations, expressed in percent.

This does not mean necessarily that there is a reduction in the range of visibility when the wind increases from 8 to 10 knots, for example. These are average values and it is assumed that strong winds are more frequent when the average velocity is 10 knots than when it is 8.

In this tabulation there is a geographical effect which renders the results questionable. Wind velocity is generally higher in high latitudes of the North Pacific than in low latitudes, hence the majority of squares with light winds are in low latitudes and vice versa. On the other hand, fog is more prevalent in high latitudes generally, thus favoring reduced visibility with the lower wind

[1] Middleton, W. E. Knowles. *Visibility in Meteorology*. Toronto, 1935.
[2] International Meteorological Organization. *Publication No. 9*, Fascicule I. Leyde, 1936.
[3] Meterological Office, Air Ministry. *The Marine Observer's Handbook*. London, 1937.
[4] Dines, L. H. G., and Mulholland, P. I. On the interrelation of wind direction with cloud amount and visibility at Cahirciveen, Co. Kerry. *M. O. Professional Notes*, Vol. 3, No. 36. London, 1924.
[5] McDonald, W. F. *Atlas of Climatic Charts of the Oceans*. Washington, 1938.

velocities there. However, another tabulation has been made, using the squares between 10° and 30° north latitude, by seasons (more than 300,000 observations) and the results are shown in figure 2 where the method of compilation is the same as in figure 1 except that seasonal instead of annual values are used. In general there is not

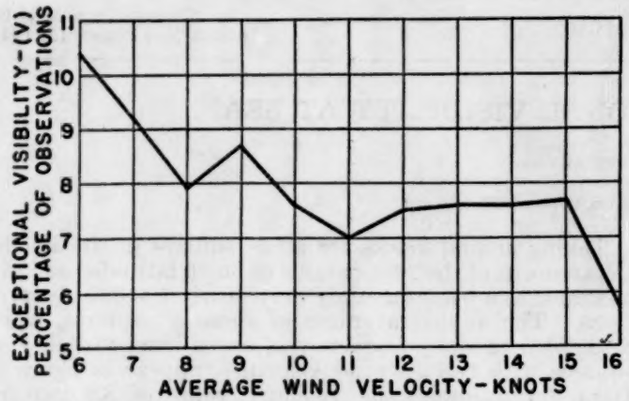


FIGURE 2.—Frequency of exceptional visibility as related to average wind velocity. Data for the North Pacific Ocean; seasonal values by 5° squares between 10° and 30° N. Frequency of exceptional visibility ("v") is the ratio of observations of "v" to the total number of observations, expressed in percent.

a pronounced variation of wind velocity with latitude in this region (10° to 30° N.), and furthermore there is not nearly so much fogginess here in summer as in higher latitudes. Figure 2 indicates that there is in general a lessening of the visual range with increase of wind move-

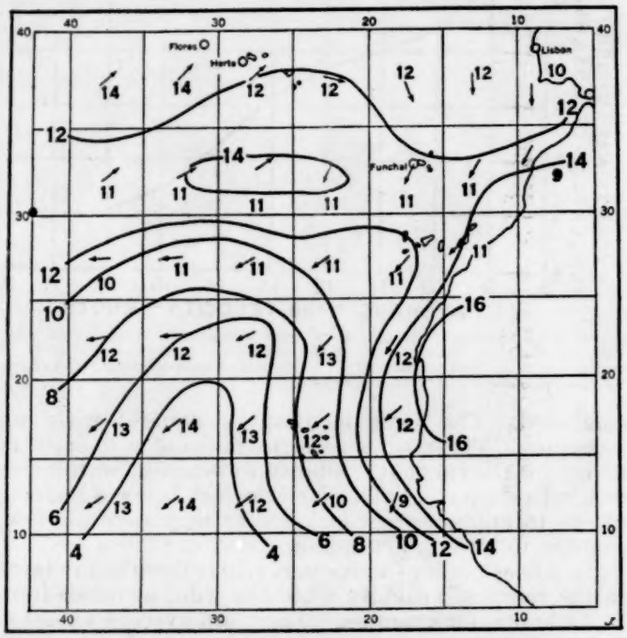


FIGURE 3.—Annual frequencies of exceptional visibility in percent (solid lines), average annual wind velocity (numbers in squares), and prevailing wind directions for the year (arrows flying with the wind).

ment. Sampling of data in other oceans gives similar indications.

Figure 3 shows the relation of the trade winds to the frequency of exceptional visibility in the southeastern North Atlantic. Here we have annual averages of exceptional visibility shown by isograms, the annual wind velocities in knots shown by figures in each 5°—square, and the prevailing wind directions for the year shown by arrows flying with the wind. It will be seen that the frequency of exceptional visibility diminishes progressively outward from the continent of Africa in the region of the trade winds. On the other hand, we see in figure 4 that the annual percentages of haze in ships' observations diminish outward from Africa. Thus it appears that dust

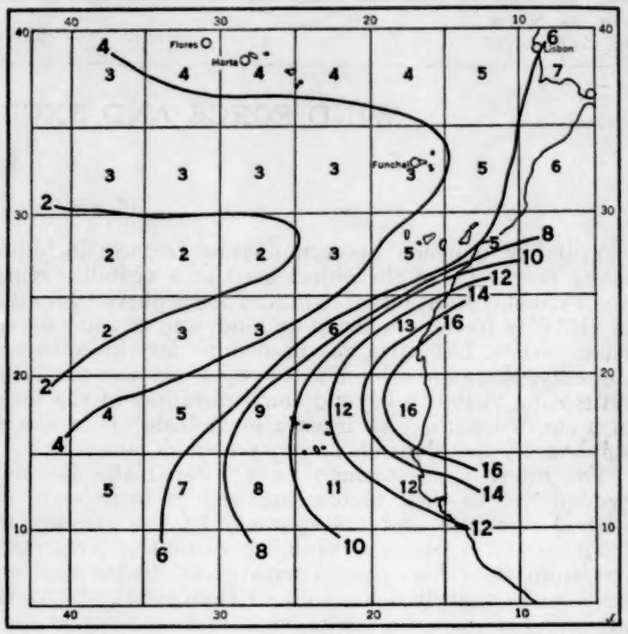


FIGURE 4.—Annual frequency of haze in percent shown by solid lines and by numbers in squares.

carried from Africa is most frequent near the coast but this does not result in lower values of the frequency of exceptional visibility near the coast. On the contrary the frequency of exceptional visibility diminishes to the leeward of the trade winds.

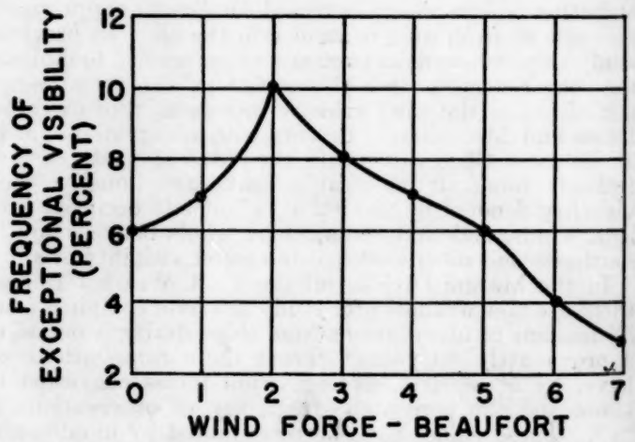


FIGURE 5.—Relation of the frequency of exceptional visibility to wind force in 18,966 ships' weather observations. Complete data are given in the table.

The results of an effort to determine the relation of wind force to the frequency of "v" in individual marine observations are shown in figure 5. In the Pacific area bounded by the Equator and the parallel of 15° north latitude and by meridians of 125° and 170° west longitude, there are available 19,261 ships' weather observations on punched cards. This area was selected because of its relatively high average wind velocity, absence of fog, and distance

from continental areas. The observations were sorted by wind forces, and the occurrences of "v" for each force were tabulated. Figure 5 shows the frequency of "v" for the various wind forces from 1 to 7, inclusive; occurrences of calms are also included. The numbers of observations used in the figure, as shown in the accompanying table, ranged from 293 for force 7 to 5,615 at force 4. For the higher forces the numbers of observations ranged from 4 (force 12) to 84 (force 8). However, there were only 5 occurrences of exceptional visibility for a total of 124 observations of wind force exceeding Beaufort 7.

It will be noted that the frequency of "v" increases (figure 5) from "calm" to force 2, and diminishes as the wind increases from force 3 to force 7. This does not necessarily mean that an increase in wind velocity from force 2 to force 3 is the cause of a local reduction in the range of vision. The obscuration is probably a result of higher velocities to windward, which are more frequently associated with local winds of force 3 than force 2.

It is known that when winds of Beaufort forces 11 and 12 prevail, horizontal visibility is greatly reduced. In the scale of wind effects upon the sea surface as originally formulated by Petersen[6] and adopted internationally with slight modifications in 1939, the description applied to Beaufort force 12 includes the statement that the air becomes so filled with foam driven away from the sea-water that vision for any distance no longer exists. In the same scale, at Beaufort force 7, the white foam is carried in streaks in the direction of the wind; this sometimes occurs at force 6, but becomes more pronounced as the wind increases; salt spray is then an important factor in reducing the range of vision.

These facts were taken into consideration in preparing the definitions of hydrometeors adopted by the Weather Bureau in 1938. A definition of "damp haze," not in the international list,[7] was introduced to provide for recording observations of a phenomenon evidently caused by strong winds at sea and which should be differentiated from thin fog.

The remarks relating to damp haze[8] are:

Description.—Microscopically small water droplets or very hygroscopic particles suspended in the atmosphere, but the horizontal range of visibility is 1¼ miles or more, usually considerably more. Similar to a very thin fog, but the droplets or particles are more scattered than in ≡ (light fog), and presumably also smaller.

General instructions.—This hydrometeor is usually distinguished from dry haze (see "haze" above) by its grayish color, the "greasy" appearance of clouds seen through "damp haze" as though viewed through a dirty windowpane, and the generally high relative humidity. Commonly observed on seacoasts, and in Southern States, most frequently with onshore winds and in the vicinity of tropical disturbances. A common mode of formation of "damp haze" is the carrying up to high levels of particles from salt water spray in windy weather. In contrast, light fog is more commonly observed when there is little movement of the surface air.

Dines and Mulholland, in connection with the investigation previously mentioned,[4] state that so-called haze is as frequently seen at Valencia Observatory when the air is damp as when it is dry, and suggest that "the limitation of the term haze to occasions when the air is dry is not very satisfactory."

Wadsworth,[9] in a study of the relation between haze and relative humidity of the surface air, concludes that "the divergence in the results for the different observatories suggests that either there has been some confusion in the use of the terms haze and mist [10] or else other causes are at work which have not been taken into account."

Owens [11] in discussing the formation of a salt haze says:

> It is evident, therefore, that the haze contained, if it did not entirely consist of, large numbers of salt crystals, and as they were probably at the time partly if not completely deliquesced, it appears to be a somewhat interesting condition—probably the transition state from a haze of dry crystals to a fog of liquid drops. It is important to note that the relative humidity at which the crystals were found to have deliquesced was 80 percent, while common salt is known to deliquesce at 74 percent to 75 percent relative humidity. The sea during the observation was rough, and doubtless one of the sources of the haze particles was the spray carried in the wind, but there was as well a large expanse of open foreshore over which sand was blowing, and this sand being wet with sea water doubtless set free salt particles into the wind.

CONCLUSION

Without considering the question of the proper designation of the phenomenon as one of a number of hydrometeors, it seems that the range of horizontal visibility on the seacoast and over the open ocean is frequently reduced because of the presence in the atmosphere of a haze composed of microscopically small water droplets or very hygroscopic particles, which is produced by the action of the wind on the sea surface, the obscuration increasing with the velocity of the wind. Stratification of the surface air, such as occurs sometimes when the sea surface is cooler than the air above it, tends to produce in low levels an accumulation of haze which is unfavorable for exceptional visibility. Ships' observations show that exceptional visibility is less frequently recorded with force 1 or calm than at force 2. At higher wind forces, however, the frequency of exceptional visibility diminishes as the wind increases. If this is true of visibility ranges in general, and not just the cases of "v" discussed here, we should expect to find an area of reduced visibility with its center lying to leeward of the central area of strong winds.

Wind force and exceptional visibility

Wind force (Beaufort)	Number of observations	Occurrences of exceptional visibility ("v")	Percentage frequency of "v"
Force not recorded	171	2	1
Calm	396	23	6
1	931	68	7
2	2,421	233	10
3	4,222	345	8
4	5,615	400	7
5	3,761	222	6
6	1,327	57	4
7	293	9	3
8	84	4	5
9	21	0	0
10	10	0	0
11	5	[1] 1	[1] 20
12	4	0	0
All observations	19,261	1,364	7

[1] The observations sorted from punched cards undoubtedly contain a few errors originating in the observations themselves or in punching the data. The occurrence at sea of exceptionally good visability with a wind of force 11 is quite unlikely, and this occurrence is probably an error. The original records are not available for verification.

[6] Petersen, P. Zur bestimmung der winstärke auf see. *Annalen der Hydrographie und Maritimen Meteorologie.* Heft III. Berlin, 1927.

[7] International Meteorological Organization. *Proces-Verbaux de la session de Salzbourg.* Pub. No. 40. Leyde, 1938.

[8] U. S. Weather Bureau. *Definitions of Hydrometeors and other Atmospheric Phenomena.* Washington, 1938.

[9] Wadsworth, J. The relation between haze and relative humidity of the surface air. *M. O. Professional Notes,* Vol. 3, No. 26. London, 1924.

[10] The term "mist," as used in the British Isles, is equivalent to a thin fog; presumably this is the meaning in Wadsworth's study.

[11] Owens, J. S. The making of a salt haze. *Phil. Mag.* 2: 1165–1170. London, 1926.

THE GEOGRAPHIC-COMPLEX METHOD FOR THE STUDY OF CLIMATE

By I. K. Tihomirov

[Polar Station of the Academy of Sciences, Kola Peninsula, U. S. S. R., May 1938]

FOREWORD

By John Leighly

[University of California, Berkeley, Calif.]

Several examples could be cited of parallelism between formulations of scientific problems arrived at in Russia and in the United States, particularly from the sciences that must consider the relation of climate to phenomena of the natural landscape. In both countries the field scientist is called upon to investigate the distribution of phenomena over vast areas in which distinctions in landscape are graded according to the continuous and elusive gradations of climate. The approximately simultaneous and wholly independent formulation in the United States and in Russia of the principle of dependence of the character of soils on large-scale contrasts in climate is the most conspicuous example that comes to mind.

Parallel approaches in the two countries to the study of climate itself might be discovered without undue effort. The present article by a Russian scientist reflects a view of climatologic investigations that has recently been expressed in the United States, though in less elaborate form, by Stanley Dodge [1] and Cornelius Muller.[2] In both countries this view has developed out of efforts to fit climatic categories more accurately than they have hitherto been fitted to the realities of the natural landscape. If they can be so fitted, argue both the author of this article, and the American authors cited, then the implied equation may be reversed so as to give, for areas from which no climatic records are available, climatic categories from observations of the landscape. Tihomirov has outlined a program for an approach to climate through its reflection in the landscape that will be read appreciatively by many Americans. Some elements of his program will undoubtedly be new to the readers of the Review; I call attention here only to his mention of the possibility of using data from plant biochemistry.

Tihomirov's article has been translated from his original Russian manuscript by N. T. Mirov, of the California Forest and Range Experiment Station at Berkeley.

INTRODUCTION

All contemporary methods of investigating climate are based on meteorologic observations supplied by a net of weather stations. Accordingly, a climatologist has at his disposal a more or less dense net of base points, at which the climatic elements are accurately recorded. For intermediate points the numerical characteristics of the climate are found by methods of simple interpolation and extrapolation. The validity of such calculations is sometimes rather limited. In regions of low relief, that possess a uniform topography, methods based on interpolation and extrapolation remain valid for very extensive areas, and weather stations may be located in such regions at intervals of perhaps about one hundred kilometers. But in mountainous countries where altitudinal climatic zones are sharply defined and where a checkerboard pattern of climate, caused by different types and orientations of mountain slopes, prevails, even the densest net of existing weather stations is insufficient for obtaining a true and detailed picture of the climate. Moreover, the method of direct interpolation and extrapolation for intermediate points in such country is altogether unreliable. Application of this method may lead to many serious errors. It can be stated without fear of contradiction that at present not a single mountainous country on the earth is well known climatologically.

The overwhelming majority of stationary weather stations are and will continue to be located in the immediate vicinity of populated places. Establishing weather stations far from such places is always a complicated and costly affair. It is safe to predict that the number of such stations will always be limited and that any increase in their number will be rather slow. Under these circumstances it is natural to inquire whether or not some climatologic method may be devised that will compensate for the lack of meteorologic data supplied by permanent weather stations.

CORRELATION BETWEEN GEOGRAPHIC LANDSCAPE AND CLIMATE

Climate is an inseparable component of the geographic landscape. Sometimes climate is the result of large-scale changes in the landscape, sometimes it is the cause of changes in the landscape. The interaction between changes in the landscape of a given part of the earth's surface and its climate is very complicated. It depends on variations in the quantity of solar radiation received, on changes in the relief of the continents and in the distribution of land and water on the surface of the earth. Systematic observations of solar radiation have been started only recently, and we do not know how it has changed during past geologic periods. Even if we assume that these changes were not great, nevertheless it is certain that the major tectonic processes of the past, that created and changed the relief of the continents and the distribution of land and water, were inevitably accompanied by corresponding changes in climate. From this point of view, climate is produced and changed through the operation of general changes in the geographic landscape of a given locality. The rapidity of such changes is determined by the rapidity of alternation of geologic periods.

Within any one geologic period the tectonics of a country remain without significant change; changes in the geographic landscape result from changes in climate. During times of tectonic stability, that is to say, the landscape is formed and changed under the influence of climate. These changes proceed more rapidly than climatic changes of tectonic origin, but the units of time involved are nevertheless of the order of geologic ages.

If we consider very short periods in the life of our planet, as for example the historical period, we see that certain elements (components) of a landscape, such as relief, distribution of land and water, or geographical position of a place, determine its climate. Others, such as the present regime of surficial and subterranean waters,

[1] The Climatic Hypothesis in Geography, *Science*, Vol. 87, 1938, pp. 85–86.
[2] Plants as Indicators of Climate in Northeast Mexico, *Amer. Midland Naturalist*, Vol. 18, 1937, pp. 986–1000.

vegetation and soil—and to a certain extent the fauna—are reflections of the existing climate.

In establishing the relation between the elements of the landscape and the regime of climate during the historical era, it should be kept in mind that this relation is often considerably disturbed by man. The cutting or planting of forests, cultivation of waste areas and the growing of fields of agricultural plants, large irrigation and reclamation projects, construction of extensive canals and hydroelectric power plants associated with such large artificial bodies of water as Lake Mead—all these activities influence the landscape to such an extent as to create a new phase of dynamic equilibrium between the elements of the landscape and the regime of the climate; and may in some degree even influence the climate itself.

The dependence of vegetation on climate has been recognized since Humboldt's time. As regards surficial waters, their dependence on climate was clearly expressed by Voeikov in 1884 in the following words:

> Other conditions being equal, the more precipitation and the less evaporation from soil and vegetation, the richer will be the country in running water * * * Therefore rivers (as well as lakes) are the products of climate.

The same idea, however, was expressed as early as 1666 by Isaac Vossius in his treatise *De Nili et aliorum fluminum origine*. Vossius wrote, *omnia flumina ex collectione aque pluvialis origine*. As all rivers are fed by underground waters in a greater or less degree, Voeikov's statement can also be applied to ground water. As far as soils are concerned, the theory of their climatic origin was advanced by Hilgard in 1889 and has been developed by later investigators.

THE GEOGRAPHIC-COMPLEX METHOD OF CLIMATOLOGIC INVESTIGATION

Vegetation, soil, and surficial waters, including snow and ice, cover in various combinations the whole surface of the earth. Every point on the earth, therefore, reflects in one way or another the climatic regime obtaining there. If it were possible to secure by some means a quantitative correlation between details of the elements of the landscape and elements of the climate, then the climatologist would have in his possession a means of ascertaining the climate of any place on the surface of the earth. This problem appears to be of outstanding importance when we consider what was said above concerning the existing net of meteorologic stations, the prospects of its expansion in the future, and the difficulties encountered in studying the climates of mountains and of other places having sparse populations.

In this method of climatologic investigation, the role of stationary weather stations would resemble that of the "bench marks" used in surveying. For intermediate points where direct observations are not possible, climatic data would be obtained by studying the phenomena of the landscape. Since the proposed method is based on the simultaneous observation of several elements of the landscape, it may be called the *geographic-complex method of studying climate*. It is obvious that this method cannot be considered a substitute for standard climatologic methods, but rather as a subsidiary procedure that aims to facilitate the gathering of data pertaining to the climates of the earth.

The dependence of vegetation, soil and hydrography on climatic conditions is so complicated that at a first glance any attempt to evaluate them quantitatively may appear to be a risky one. However, the returns that are promised even by a partial solution of the problem seem to be sufficient to justify an attempt. The problem as a whole is complicated enough, but a partial solution seems to be wholly feasible.

The geographic-complex method of investigating climate calls for the application of some sciences and methods that are rather foreign to contemporary climatology. It calls for the cooperation of climatology, ecology, plant biochemistry and plant physiology, soil science, hydrology, and geomorphology. The climatologist should divorce himself from conventional office work with figures obtained from meteorologic observations. He should instead familiarize himself with the region under investigation. He should gather his data by means of a series of climatologic expeditions and then work out his findings with a microscope or in the chemical laboratory, with the final aim of giving a picture of the climate of the region. If the geographic-complex method is to be applied practically, two problems must be solved:

First, the discovery in the landscape of climatic indicators that possess quantitative functional relations to certain elements of climate or to certain combinations of these elements; and second, the development of methods for determining "reduction factors" to be used in translating numerical values of the landscape indicators into numerical values of climatic indicators. These two problems can be solved by research at a fixed station, the results obtained in the office being verified by observation in the field. Climatologic expeditions appear to be the best field method in the geographic-complex study of climate.

CLIMATIC INDICATORS IN THE LANDSCAPE

At present only a few landscape indicators of climate are known. It is believed that through broad systematic study a number of indicators may be found, of which the most significant ones may be selected for use. In searching for indicators it is essential to avoid tying up a certain indicator too rigidly with the whole range of fluctuation of a single climatic element, or a mechanical application of the same indicator in different types of climate.

Each indicator should be used only locally, and its significance in different seasons of the year should be ascertained. Landscape indicators of climate are no more nor less than witnesses' statements given by the vegetation, soils and waters of a given locality concerning its climatic regime. All such "statements" have a very individualistic character and may be distorted by many circumstances. Therefore it appears necessary to make certain the possibility of cross-checking any climatic phenomenon with many indicators and to arrive through numerous observations at the conclusions sought. It may happen that a given indicator will reflect a certain complex of climatic elements, and again that a given element of climate will be characterized, not by one indicator, but by many indicators taken together.

In this connection, a question may arise in the future as to the necessity either of supplementing the present system of measured climatic elements with complex quantities computed from observed data, or of differentiating the elements observed at present. Finally, landscape indicators of climate should be selected so that they will characterize the results of the prolonged operation of a climatic element, of its cyclic variations and of the extreme values that it assumes.

This is of course a maximum program; but if a solution cannot be attained with the help of one indicator, it would perhaps be possible to achieve it with the aid of another or of a combination of several indicators.

Let us consider some more or less familiar climatic indicators in the landscape. The most generally familiar one is increment of tree growth. Numerous investigations, mostly carried out in the United States, have been devoted to the study of the thickness of annual rings and of growth in height, chiefly in relation to amount of precipitation and temperature of the air.

Such investigations have been conducted from a silvicultural or a paleoclimatologic point of view; sometimes they have the appearance of being mere deductions from some combination of the observational data. The results of these investigations are rather controversial. Their dubious character may be explained by the lack of a uniform methodology and by the great variety of field data. On the other hand it may be explained by the fact that in different regions the woody vegetation reacts differently to changes in climatic regime. In arid regions, for example, increment in diameter reflects chiefly the precipitation regime, while in northern latitudes, where moisture is abundant, the temperature regime is of more importance.

It is possible that a comparison of magnitude of increment in trees with magnitude of evaporation would give interesting results. Tree growth is undoubtedly also affected by temperature and moisture of the soil, but these factors in their turn are linked with air temperature and precipitation. Less known but very valuable indicators of temperature are biochemical ones. The investigations of S. L. Ivanov in the Soviet Union have shown, for example, that the iodine-number of fats contained in seeds can be used as a very accurate indicator of the temperatures prevailing in the place where the parent plant grew. Among biochemical indicators, indicators of radiation should also be mentioned.

It would appear that plant biochemistry will provide the largest number of climatic indicators. Climatologists should therefore pay the utmost attention to the possibilities that plant biochemistry offers.

Flag-like crowns of trees, especially on mountains, and probably differences in the concentric pattern of the annual rings as well, may be used as indicators of the direction of prevailing winds. In deserts the orientation of sand dunes may be used as wind indicators. Peculiarities in the location of crowns of trees in arctic regions may serve as indicators of depth of snow cover. Humidity of the air may perhaps be judged by the degree of pubescence of certain species of willows, or of other suitable plants.

The possibility is not excluded that soil qualities may be used as climatic indicators. The extent of frozen soil may be ascertained by study of the development of the root systems of plants.

Study of the regime of bodies of water has as yet been neglected by climatologists. Yet the study of the details of surface run-off in mountainous country and of the characteristics of temporary or permanent mountain streams may yield most reliable information regarding amount and intensity of precipitation. Particular attention should also be paid to the regimen of swamps.

The above list of climatic indicators is neither complete nor systematic. This list, which is adapted to the temperate zone, is given merely as an illustration, and it could of course be greatly amplified by the inclusion of a multitude of edaphic, geologic, hydrologic, geomorphologic and phenologic indicators.

For the purposes of the geographic-complex study of climate, indicators that react quantitatively to variations in the climatic elements will be most significant. But at the same time merely qualitative indicators should not be neglected. The latter probably will always predominate in number and a skillful cross-examination of such indicators may be very useful in the complicated problem of constructing a picture of the regime of the climate.

Monographic studies of individual indicators will assist in selecting the most significant ones and will constitute the most convenient procedure. These monographic studies will also help in developing the technique of gathering data pertaining to a given indicator and evaluating its seasonal and geographic significance.

DETERMINATION OF REDUCTION COEFFICIENTS (FACTORS)

The general considerations stated above are equally applicable to the second problem of the investigation of climate by the geographic-complex method; namely, the determination of the reduction factors (coefficients) that are to be used for converting the numerical values of the landscape indicators into climatic indices. These reduction coefficients would be found through comparison of the numerical values of the landscape indicators in the immediate vicinity of meteorologic stations with the numerical values of the climatic elements obtained by direct observation at the stations. The technique of solving the problem would be worked out in the actual process of determining the separate reduction coefficients. It is unnecessary to state that in calculating these coefficients, as in the definition of climatic indicators, it will be impossible to use a uniform routine approach. The most dangerous approach would be a mechanical "bookkeeping" method consisting in the comparison of the values of landscape indicators with mean annual and monthly climatic data, without a substantial preliminary understanding of the dynamic relation of the landscape indicators to the climatic elements that determine them.

Moreover, it will be impossible to assign *a priori* a permanent significance to the reduction coefficients. It is probable that these coefficients will have an annual march and will be applicable only to a certain geographic region. In practice, the methodology both of the definition of climatic indicators and of the determination of reduction coefficients should be worked out simultaneously. In the former the leading role belongs to botany, pedology, or hydrology—depending on the peculiarities of the landscape indicator used—while in the latter the leading part is played by climatology. These circumstances determine the distribution of work among different specialists until the time when climatologists become familiar with the information to be drawn from auxiliary sciences that is necessary in order that the relations existing in Nature between landscape and climate may be understood.

CONCLUSION

The present article has aimed merely to present the general ideas of the proposed method for the study of climate, and to show in broad outline a practical way of developing the method. The complexity of the relation that exists between climate and landscape is fully appreciated. But the multitude and variety of the objects in Nature that reflect climate provide a wide and promising field for the search after the indicators of climate in the landscape. Such a search, properly organized and employed on a large scale, will undoubtedly reveal means for simplifying the entire problem and will also yield a considerable amount of accessory information sufficient for the practical realization of the proposed method of climatologic investigation.

TROPICAL DISTURBANCES OF AUGUST 1940

By JEAN H. GALLENNE

There were three tropical disturbances in the North Atlantic and the Gulf of Mexico during the month of August. The earliest, that of the 2d–10th, was confined to the Gulf of Mexico. The second, that of the 5th–17th, was of the West Indian type and its course lay over the North Atlantic ocean. The third originated over the North Atlantic Ocean rather late in the month and will be described in the September REVIEW.

DISTURBANCE OF AUGUST 2–10

This disturbance had its inception in the southern end of an extra-tropical low-pressure trough which moved off the coast of South Carolina and Georgia. A wave developed on August 2, off Jacksonville, Fla., and moved southwestward across Florida into the northeast portion of the Gulf of Mexico by the 3d, where a rather shallow LOW 1,012.5 millibars (29.90 inches), with definite cyclonic wind circulation was charted. The disturbance moved steadily west-southwestward with increased intensity during the next 24 hours and ships' reports indicate that it was centered on the morning of August 4 near latitude 28° N., and longitude 87° W., from where it progressed in a slight curve to the right during the 4–5th.

Heavy rain squalls and fresh to strong shifting gales were encountered by vessels in the central and north-central portions of the Gulf of Mexico on August 5, 1940. At 12:50 a. m., of the 5th, the American S. S. *Connecticut*, near latitude 26°45′ N., and longitude 88°06′ W., reported a barometer reading 1,004 millibars (29.64 inches), strong gales and rough sea; the wind increased to force 11 (Beaufort scale) shortly after 2 a. m. This is the highest wind of record reported from any vessel in connection with this disturbance. At 7 a. m., on August 5, the center of the storm was charted about 110 miles southeast of Port Eads, La. The American motor vessel *Rhode Island* at 6:07 p. m., of the same day met south-southwest winds of force 9, with rough sea and very heavy rain.

The disturbance continued in a west-northwest direction during the 6th which carried the center south of the Louisiana coast toward Texas, where it passed inland on August 7, just east of Sabine. The storm at this point was of small diameter, with the path of hurricane winds about 20 miles wide in the Port Arthur-Sabine area.

The following table gives the recorded maximum wind velocities and the lowest pressures at stations on and near the Gulf coast, during the passage of the disturbance.

Station	Wind	Time	Lowest pressure, inches	Time
Apalachicola, Fla.	32-NE.	5th-3:43 a. m.	29.82	4th-5:30 p. m.
Pensacola, Fla.	34-SE.	5th-7:38 a. m.	29.82	4th-6:00 p. m.
				5th-3:00 a. m.
Mobile, Ala.	29-NE.	6th-6:01 a. m.	29.84	5th-2:00 a. m.
New Orleans, La.	32-E.	6th-4:55 a. m.	29.71	6th-6:15 a. m.
Burrwood, La.	51.	6th-7:00 a. m.	29.40	6th-3:00 a. m.
Lake Charles, La.	50-E.	7th-9:30 a. m.	29.50	7th-7:30 a. m.
Port Arthur, Tex.	82-NE.	7th-12:47 p. m.	28.87	7th-1:15 p. m.
Galveston, Tex.	34-NW.	7th-4:10 p. m.	29.50	7th-7:00 p. m.
Houston, Tex.	30-NW.	7th.	29.55	7th-7:00 p. m.

An extract from the report of E. W. Torrence, meteorologist in charge at Port Arthur, Tex., follows:

The barometer began a definite downward movement as early as 10 a. m. of the 6th. The fall was rapid from 8 a. m. to the low point at 12:15 p. m. Recovery immediately after the minimum pressure was even more rapid than the fall. At Port Arthur the lowest pressure for this station was 977.7 millibars (28.87 inches), considerably lower than the previous low barometric pressure reading of 994.5 millibars (29.37 inches) recorded on October 16, 1923. The 5-minute maximum was 82 miles an hour from the northeast at 11:47 a. m., and the 1-mile extreme was 91 miles per hour. The total rainfall from midnight of August 6–7 to noon of the 8th was 5.87 inches.

During the evening of August 7, the storm recurved to the right with accompanying marked increase in rainfall over southwest Louisiana. At 7 a. m. of the 8th, it was centered a short distance northeast of Houston, Tex., with decreased intensity. For the next 48 hours the disturbance moved rather slowly in a north-northeasterly direction, dissipating on the evening of August 10 in north-central Arkansas.

From reports at hand, indications are that only one death resulted from the storm. A Chinese fisherman was drowned in Barataria Bay, north of Grand Isle. Losses in crops, roads, and property damage due to wind and heavy rainfall, are estimated at more than $1,743,550.

Passage of this hurricane from the eastern Gulf of Mexico was completely covered by warnings and advisories by the Weather Bureau forecast center at New Orleans, La.

DISTURBANCE OF AUGUST 5–17

The morning charts of August 5 showed some indications of a slight disturbance centered between St. Martin and St. Thomas Islands. Severe squalls of 44 miles an hour were recorded at 10:04 a. m. at San Juan. By 6 p. m. of the 5th, the depression was located a short distance north of Mona Passage, having moved very rapidly in a west-northwestward direction during the preceding 10 hours. The Dutch motor vessel *Pygmalion*, near latitude 19°36′ N. and longitude 65°48′ W., at 5 p. m. of August 5, reported fresh easterly gales with barometric pressure 1,012.5 millibars (29.90 inches).

Cloudy weather with high winds and moderate to rough seas was encountered by ships in the vicinity of the path of the disturbance as it continued to move in a west-by-north direction during the 6th. The center passed a short distance to the south of Turks Island at noon of August 6, with deepening pressure, 1,003 millibars (29.63 inches) accompanied by winds of 30 miles an hour.

During the next 3 days the disturbance showed little tendency to increase in intensity as it moved to the northward. It was located near latitude 29°41′ N., and longitude 74°15′ W., on the morning of August 9. At 4 a. m. of August 10, the American tanker *Meton*, near latitude 32°12′ N., and longitude 77°42′ W., recorded a barometer pressure reading of 1,008.5 millibars (29.81 inches), with overcast squally weather, east winds of force 8, and high seas.

The first indications that this storm had developed to hurricane intensity were received from the American S. S. *Maine*, giving her noon position as approximately 32°03′ N., and longitude 77°18′ W. The ship's daily journal of August 10th shows that the vessel met east-southeast wind, force 10 increasing to full hurricane strength at 4 p. m. (local ship's time), with very high and rough east-southeasterly sea, large heavy swell and poor visibility. The barometer fell very rapidly until about 8 p. m., when it became steady and began to rise slowly.

The hurricane crossed the coast at about 4 p. m. of August 11, near Beaufort, S. C., where moving inland,

its course curved to the westward, passing just north of Savannah, Ga., between 5 and 6 p. m. on the same day A report of the storm by the forecaster at Jacksonville Fla., Grady Norton, includes the following:

The lowest pressure at Savannah was 28.78 inches (974.7 mb.) and highest wind 73 miles per hour from north, just before passage of center. A lull occurred from 5 to 6 p. m., during which the wind dropped to 9 miles per hour, then shifted to south and increased to whole gale. Winds of hurricane force were experienced from the Savannah area nearly to Charleston, (Charleston maximum velocity 66 miles per hour for 5 minutes) a distance of about 90 miles. Damaging gales extended north of Charleston to Georgetown and south of Savannah to Brunswick. Tides were very high north of the center, Charleston reported 10.7 feet above mean low tide.

Property damage amounted to about $1,500,000 at Charleston and nearby beach resorts, nearly $1,000,000 in the Savannah area; and about $500,000 elsewhere between these places, much of which was at Beaufort, S. C. The total damage to property along the coast was, therefore, about $3,000,000. Reports are somewhat confused as to loss of life. The larger communities (Savannah, Beaufort, and Charleston) had very few casualties; none occurred at Charleston and Beaufort and only two at Savannah, and one of these was by heart failure due to fright, rather than injury. In the coastal area between Savannah and Charleston a considerable number lost their lives. Early press reports indicated 35 dead but some at first thought dead were later found safe and the exact number may never be known, but it is believed to be not more than 20 for the entire coastal area.

The coast is indented by many inlets, islands, marshes, etc. Some of these islands are inhabited by Negroes living in flimsy shanties or houseboats, without communication facilities and hard of access. The small number of deaths under these conditions is considered remarkable, and indicates the effectiveness of the Coast Guard and other agencies in reaching these remote people with the warnings and getting most of them to places of safety in advance of the storm. In addition to these rather inaccessible places, there are a number of popular beach resorts ordinarily visited by thousands of people over week-ends. A particular attraction this Sunday was to be a yacht race at Charleston. The small crafts were moved to safe achorage and the beaches cleared of people. It will be seen, therefore, but for the effectiveness of the warnings, the loss of life and property would have been much greater.

Aside from the doubtless saving of many lives, the money value of property saved was several hundred thousand dollars, probably $500,000 in small craft and automobiles alone. It will be seen, therefore, that the value of property saved in this one storm would be sufficient to maintain the entire hurricane warning service for many years.

After leaving the coast the storm moved slowly to the southern Appalachian Mountain region attended by torrential rains and disastrous floods in many sections of Georgia, Tennessee and the Carolinas. Press reports indicate more than 30 deaths and property damage of many millions of dollars in these flood areas, as well as tremendous crop damage. This indicates that the storm caused far more damage and destruction by the floods than by the hurricane winds it gave in the coastal sections.

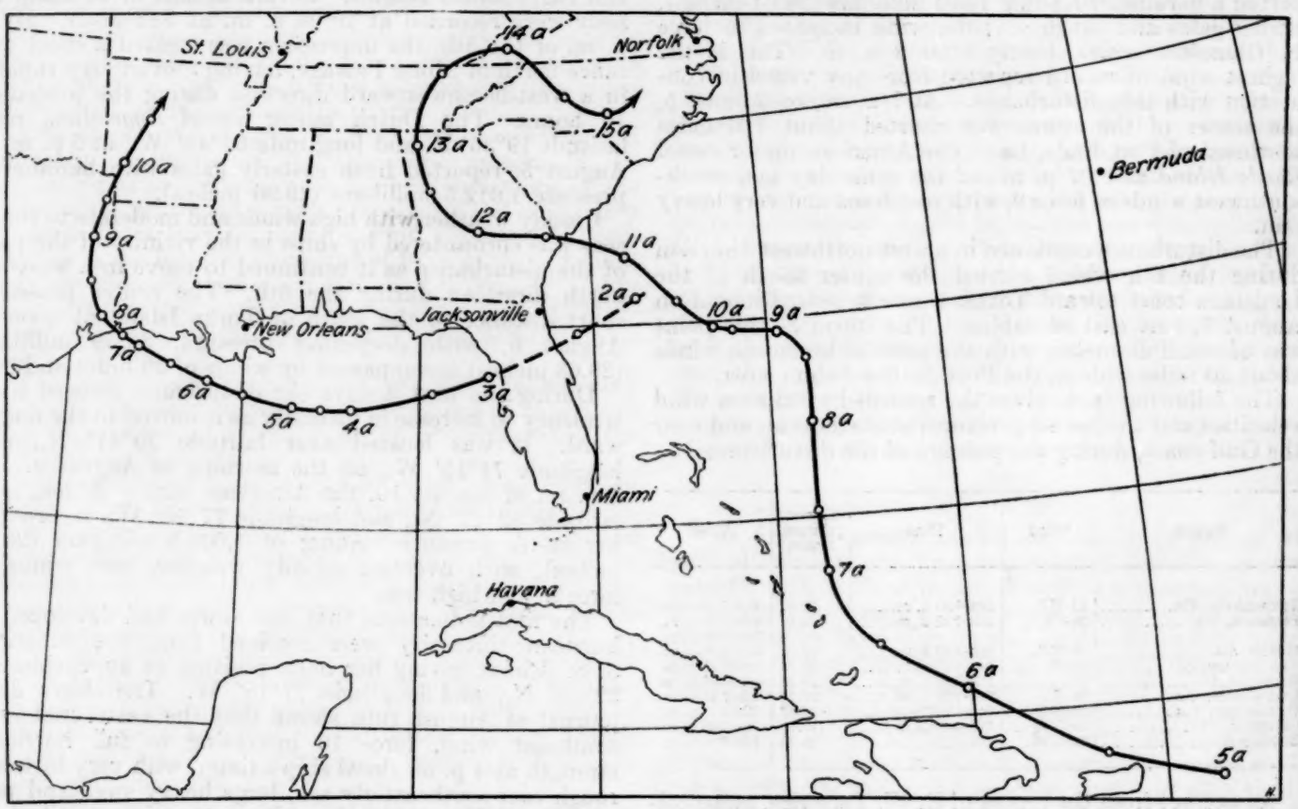
A preliminary report of river and flood conditions associated with this disturbance will be found elsewhere in this REVIEW.

During the afternoon of August 11, a sea-level pressure reading of 974.7 millibars (28.78 inches) was recorded at Savannah, Ga. This is the lowest ever recorded at the Weather Bureau Office at that place.

During the next 4 or 5 days, as the storm moved overland, it diminished rapidly in intensity and its progressive motion was rather erratic. Its positive identity was lost on August 15.

Timely and accurate warnings were issued from the Weather Bureau Offices at San Juan, Jacksonville, and Washington, D. C., covering the movements of this hurricane.

Approximate tracks of both the disturbances described in this article are shown on the accompanying chart.



NOTES AND REVIEWS

SVERRE PETTERSSEN. *Weather Analysis and Forecasting.* New York (McGraw-Hill Book Co.), 1940. 505 pp., 249 figs.

The purpose of this book is to assemble the practical methods now available (most of them developed comparatively recently) for forecasting weather on the basis of physical principles. A general knowledge of meteorology is presupposed, and only those aspects of meteorology are treated which experience has shown to be directly applicable to actual forecasting. The book embodies the original theoretical investigations and the accumulated experience of the author in synoptic meteorology over a long period of years. The author's methods are distinguished by the introduction of precise formulations of synoptic concepts, in terms of quantities that can be measured in ordinary meteorological observation.

The first chapter contains a brief treatment of 17 different quantities in terms of which the physical characteristics of air masses may be described. It is followed by a chapter on the theory of atmospheric stability, convective phenomena, and fog, and the uses of various thermodynamic diagrams. Chapter III discusses the source regions, production, classification, and transformation of air masses. Two chapters are then devoted to the fundamental dynamical equations of motion, the gradient wind, kinematic analysis, frontogenesis, and the characteristic phenomena of fronts, followed by a chapter on waves and the wave theory of cyclones. Chapter VIII is on isentropic analysis, and was written by Jerome Namias. Two chapters on the kinematic forecasting of the displacements of pressure systems, fronts, and air masses, and the forecasting of deepening and filling, are followed by the concluding chapter on the actual technique of analysis and forecasting, with several examples.

EDMUND SCHULMAN. A Bibliography of Tree-Ring Analysis. *Tree-Ring Bulletin* (University of Arizona, Tucson), Vol. 6, No. 4, April 1940. This entire issue of the *Tree-Ring Bulletin* is devoted to a 12-page bibliography comprising 412 titles on tree-ring analysis.

METEOROLOGICAL AND CLIMATOLOGICAL DATA FOR AUGUST 1940

[Climate and Crop Weather Division, J. B. KINCER in charge]

AEROLOGICAL OBSERVATIONS

By EARL C. THOM

The mean surface temperatures during August (Chart I) were above normal over most of the United States; temperatures were slightly below normal, however, over considerable of the western part of the Mississippi River Valley area, and a small area in northeastern Texas had temperatures from 2° to 3° (F.) below normal. Temperatures were also below normal over the northern Atlantic States, with temperatures about 3° below normal in New Jersey and eastern New York. The warmest area for the month, relative to the normal, was Montana, western Wyoming, northern Utah, and northern Nevada with mean temperatures about 5° above normal in most of this area.

At the 1,500-meter level the direction of the resultant winds for the month (chart VIII) was considerably to the north of normal (clockwise turning) over the Atlantic Coast States and also over eastern Texas. The direction of the resultants for the month had the opposite turning over the Great Lakes and the east central states. The same general diversion from normal in the direction of the resultant winds for August occurred at the 3,000-meter level as at the 1,500-meter level, except that the shift of direction to northward was more pronounced over eastern Texas and extended over Oklahoma. Based on data for the small number of stations for which 5 a. m. normal records are at hand, the direction of the resultant wind for the month at 5 p. m. was south of the corresponding 5 a. m. normal over the eastern half of the country and over the extreme northwest with the opposite shift occurring over the remainder of western United States.

The 5 a. m. resultant velocity for August was in general below the normal resultant velocity over the United States at both the 1,500-meter and the 3,000-meter levels. The resultant velocity was about 3 meters per second below normal at the 1,500-meter level along the northern Atlantic coast and at Fargo, N. Dak., while the corresponding velocity was slightly over 4 meters per second below normal for the 3,000-meter level at Fargo and Sault Ste. Marie. At the 5,000-meter level the 5 p. m. resultant normal was considerably above the corresponding 5 a. m. velocity over the South Central States and was considerably below this normal over the Northeast and North Central States.

Again in August the areas having a decided shift in direction of the resultant winds from normal, at both the 1,500-meter and the 3,000-meter levels, agree well with the areas having corresponding surface temperature departures for the month.

At the 1,500-meter level the direction of the 5 p. m. resultant for the month was south of the corresponding 5 a. m. resultant (counterclockwise turning) over a large part of the United States. The opposite shift in resultant wind direction at this level occurred over the Great Lakes and part of the North Atlantic States, over part of the Southeastern States and over most of the extreme western and extreme southwestern portions of the country. At the 3,000-meter level the shift of the resultant wind to the northward from 5 a. m. to 5 p. m. was noted over larger areas, this shift having occurred over the Gulf coast, southern Atlantic coast, part of the east Central States, over the Pacific coast and most of the Southwest and West Central States.

The changes in resultant velocity at 5 p. m. from those at 5 a. m. were well distributed at both the 1,500-meter and the 3,000-meter levels. At the 1,500-meter level, however, the West Central, the Central, and the Southeastern States all showed lower resultant velocities at 5 p. m. than at 5 a. m., the velocity departures in this area amounting to a decrease of Beaufort force one or two.

It is of interest to note that at Las Vegas, Nev., the pilot balloon observations attained a height of 18 kilometers or over on 16 days during the month and that the resultant wind, based on those observations was 118° (ESE), 2.0 meters per second for that level.

The upper air wind data discussed above are shown in table II and in charts VIII to XI.

At all levels from 3,000 meters up to at least 17,000 meters over the United States (table I) the highest mean monthly pressures for the month of August occurred over the extreme southwestern part of the country; the maximum occurred at Phoenix at most of these levels. At

several of the levels above 8,000 meters, however, the mean pressure at other stations (Brownsville, San Diego, or El Paso) were the same as at Phoenix. The lowest mean monthly pressure occurred at Sault Ste. Marie at the 15,000-meter level as well as at all levels from 3,000 meters to 13,000 meters inclusive. At the 14,000-meter level the same minimum pressure, 151 mb., was recorded at Great Falls, Mont., and at Sault Ste. Marie, Mich., while 110 mb. pressure was recorded at three stations, Great Falls, Joliet, and Sault Ste. Marie, at the 16,000-meter level.

Mean monthly pressures were the same or lower in August than in July at most stations for all levels below 5,000 meters. At higher levels mean pressures were higher in August than in July over the eastern half of the United States and along the Pacific coast with little change over the rest of the United States. The station showing the largest increase in mean pressure at upper levels from July to August was Sault Ste. Marie, this increase being 4 mb. at 8,000 meters, 6 mb. at 11,000 meters, and 5 mb. at 14,000 meters over this station.

The greatest difference between the mean maximum pressure for August and the corresponding mean minimum was 12 mb. which occurred at the 8,000-meter level. The steepest pressure gradient at this level occurred between Lakehurst and Washington where a difference of 3 mb. was noted along a horizontal distance of less than 200 miles. Another steep pressure gradient, a difference of 5 mb., occurred between Sault Ste. Marie and Joliet.

At levels below 8,000 meters the mean temperatures were in general higher in August than in July over the Great Lakes and East Central States and along the Pacific Coast and were lower than in July over the balance of the country. Almost without exception mean temperatures were higher than in July at all thousand-meter levels from 9,000 meters to and including 13,000 meters. At the 14,000-meter level four stations in the eastern half of the country and one in the western half had mean temperatures in August lower than those in July. At levels from 15,000 meters to 18,000 meters inclusive, mean temperatures were generally lower than in July except that in the southwest temperatures were higher. At El Paso, for example, the temperature at these four levels averaged nearly 2° C. higher than in the previous month.

At levels below 5,000 meters mean temperatures were generally lower than in August of 1939 except over the Southeast, the Gulf Coast and over the West Central States where small increases in temperature from those of the preceding year were noted. At most of the thousand-meter levels from 5,000 to 14,000 meters inclusive, temperatures were lower than in 1939 at Oakland and at Joliet and were higher than 1939 at Denver and El Paso. At most other stations no marked temperature changes from the previous year were evident.

The maximum altitude of the level of mean freezing temperature for August was 5,100 meters over Phoenix and the minimum altitude of this level was 3,700 meters over Sault Ste. Marie. The altitude of mean 0° C. temperature was 4,900 meters or higher at all Weather Bureau Stations south of 35° N. latitude, while the corresponding altitude ranged between 4,400 meters and 4,800 meters for such stations in the United States between 35° and 45° latitude and was the same or lower for all stations north of this latitude belt. The altitude of the level of average freezing temperature was several hundred meters higher than in July over the eastern half of the country, the maximum increase of 800 meters occurring over Sault Ste. Marie.

The lowest free-air temperature at standard one thousand meter levels in August was −82.6°C. (−116.7° F.) recorded at 16,000 meters over Brownsville, Texas. Minimum temperatures of −70° C. (−94° F.) or lower were recorded at all radiosonde stations in the United States south of 35° N. latitude while the minimum recorded at all stations (except Lakehurst) north of this line was −70° C. or higher, with the highest minimum observed in the United States, −63.2° C. (−81.8° F.) occurring at Bismarck, N. Dak.

Table 3 shows the maximum free-air velocities and their directions for various sections of the United States during August, as determined by pilot-balloon observations. The extreme maximum for the month was 53.6 meters per second (119.9 miles per hour) observed over Huron, S. Dak. on August 5, 1940. This high wind was blowing from the west at an elevation of 9,540 meters (nearly 6 miles) above sea level. A maximum, 58 meters per second, for the month of August occurred last year over Huron, S. Dak. at 13,740 meters above sea level. In August 1938 a still higher maximum wind, 69.8 meters per second, was observed at an elevation of 2,660 meters over Havre, Mont.

Tropopause data for August showing the mean altitude and temperature of the tropopause at various stations are shown in table 4 and on chart XIII.

MEAN ISENTROPIC CHART [1]

Two anticyclonic eddies are the most prominent features of the mean isentropic chart (θ=314°) for August 1940 (chart XII). The eastern cell is displaced southward of its usual position, resulting in above normal precipitation in the Middle and South Atlantic States, but with large deficiencies in New York and New England. Downslope motion is indicated by the resultant winds in the region west of the Rockies, where little or no precipitation occurred; but over the upper Mississippi Valley marked upslope components are shown, and as a consequence the precipitation was above normal. The large excesses in precipitation in Louisiana, as well as those in North Carolina and Virginia, were due largely to tropical cyclones the effect of which was not prolonged enough to show up on the mean moisture pattern.

The data for Medford, Oreg. were neglected in constructing chart XII because the mean there was based on only 18 observations.

[1] Prepared by the Research Division.

TABLE 1.—*Mean free-air barometric pressure in millibars, temperature in degrees Centigrade, and relative humidities in percent, obtained by airplanes and radiosondes during August 1940*

Altitude (meters) m. s. l.	Stations and elevations in meters above sea level																							
	Bismarck, N. Dak. (505 m.)				Brownsville, Tex. (6 m.)				Charleston, S. C. (14 m.)				Coco Solo, C. Z.[1 2] (15 m.)				Denver, Colo. (1,616 m.)				El Paso, Tex. (1,193 m.)				Ely, Nev. (1,908 m.)			
	Number of obs.	P.	T.	R. H.	Number of obs.	P.	T.	R. H.	Number of obs.	P.	T.	R. H.	Number of obs.	P.	T.	R. H.	Number of obs.	P.	T.	R. H.	Number of obs.	P.	T.	R. H.	Number of obs.	P.	T.	R. H.
Surface	31	957	18.2	68	27	1,013	26.5	85	30	1,014	24.0	91	17	1,013	25.5	96	31	842	18.3	62	21	882	23.6	49	31	811	17.5	28
500					27	958	24.5	87	30	960	22.9	79	17	958	24.2	94												
1,000	31	904	20.4	55	27	905	22.5	68	30	906	20.3	74	17	904	22.1	92												
1,500	31	852	18.0	54	27	854	20.5	57	30	855	17.7	74	17	854	19.6	91												
2,000	31	804	15.1	53	27	805	17.9	53	30	806	15.0	70	16	805	17.1	86	31	805	19.2	57	21	852	23.3	47				
2,500	31	757	12.2	53	27	760	15.0	53	30	760	12.3	68	15	759	14.3	84	31	759	16.2	56	21	804	20.8	47	31	803	20.2	25
3,000	31	713	9.0	53	27	716	12.1	55	30	716	9.7	66	15	714	11.8	82	31	715	12.9	56	21	759	17.2	49	31	758	20.1	24
4,000	31	632	2.9	46	27	635	6.1	57	29	634	4.8	60	11	633	6.0	75	31	634	5.7	62	21	715	13.4	54	31	715	16.4	24
5,000	31	558	−3.8	40	27	561	−.2	55	29	561	−.6	56					29	560	−2.0	66	20	634	6.1	58	31	634	7.6	28
6,000	31	490	−10.4	36	27	495	−5.5	45	28	494	−6.2	51					29	493	−9.0	65	20	561	−.8	63	31	560	−1.5	38
7,000	31	430	−17.4	32	27	435	−11.7	38	28	434	−12.1	47					28	433	−15.2	62	20	495	−6.8	56	31	494	−9.7	45
8,000	31	376	−25.1	31	27	381	−18.8	35	28	381	−19.1	47					28	379	−22.0	59	20	435	−12.7	53	31	433	−15.8	42
9,000	30	326	−32.8	29	27	333	−26.1	33	27	332	−26.7	46					28	330	−29.7	57	20	381	−19.5	52	31	378	−22.9	38
10,000	28	282	−40.3	----	27	289	−33.8	33	27	288	−34.9	44					29	286	−37.8	55	20	332	−26.9	51	31	329	−30.9	35
11,000	28	243	−47.3	----	26	250	−41.5	----	27	249	−43.0	----					28	246	−45.1	----	20	288	−34.5	50	31	286	−38.5	32
12,000	28	209	−52.7	----	25	216	−48.9	----	24	214	−50.8	----					26	212	−51.5	----	20	249	−42.3	----	30	246	−45.7	----
13,000	28	178	−55.5	----	25	185	−56.0	----	23	183	−58.1	----					26	182	−56.9	----	20	215	−50.0	----	29	212	−51.8	----
14,000	25	152	−57.5	----	24	158	−62.6	----	23	156	−64.1	----					25	155	−61.5	----	20	184	−56.9	----	29	181	−56.6	----
15,000	24	130	−59.1	----	24	134	−68.2	----	22	132	−68.7	----					23	132	−64.3	----	20	157	−62.8	----	29	154	−61.2	----
16,000	24	111	−59.1	----	23	113	−71.3	----	21	112	−69.3	----					22	112	−65.1	----	20	133	−67.1	----	29	131	−64.6	----
17,000	24	94	−58.9	----	23	95	−70.6	----	20	95	−67.3	----					19	93	−64.3	----	20	113	−69.1	----	28	112	−64.8	----
18,000	21	80	−57.1	----	20	81	−67.4	----	18	80	−63.9	----					18	81	−62.1	----	20	95	−68.1	----	26	95	−63.5	----
19,000	13	69	−55.8	----	20	68	−64.4	----	16	68	−61.3	----					16	69	−59.7	----	20	81	−65.7	----	25	80	−61.0	----
20,000	7	58	−54.6	----	17	58	−61.6	----	9	58	−59.3	----					9	59	−57.4	----	17	69	−62.7	----	19	69	−58.7	----
21,000	5	51	−53.1	----	12	49	−58.5	----	6	49	−57.6	----					6	50	−55.6	----	12	58	−60.0	----	12	58	−56.4	----
22,000					7	42	−55.7	----																				

Altitude (meters) m. s. l.	Stations and elevations in meters above sea level																							
	Great Falls, Mont. (1,117 m.)				Joliet, Ill. (178 m.)				Lakehurst, N. J.[1] (39 m.)				Medford, Oreg. (401 m.)				Nashville, Tenn. (180 m.)				Norfolk, Va.[1 2] (10 m.)				Oakland, Calif. (2 m.)			
	Number of obs.	P.	T.	R. H.	Number of obs.	P.	T.	R. H.	Number of obs.	P.	T.	R. H.	Number of obs.	P.	T.	R. H.	Number of obs.	P.	T.	R. H.	Number of obs.	P.	T.	R. H.	Number of obs.	P.	T.	R. H.
Surface	31	890	19.9	32	29	995	19.3	85	31	1,014	17.0	92	19	967	22.4	41	31	995	22.9	84	27	1,019	22.8	87	31	1,014	15.6	84
500					29	959	20.7	70	31	961	16.8	72	19	956	22.7	40	31	959	23.5	73	27	963	21.4	79	31	957	15.7	73
1,000					29	905	18.7	68	31	907	14.8	68	19	902	20.9	41	31	906	21.1	73	27	909	18.5	74	31	902	21.1	38
1,500	31	852	20.4	32	29	853	15.8	72	31	854	12.4	66	19	851	17.9	47	31	855	17.9	76	27	857	15.4	72	31	852	20.4	26
2,000	31	803	17.5	33	28	804	12.9	76	31	805	10.3	60	19	802	15.8	49	31	806	14.7	75	27	808	12.1	69	31	803	18.0	21
2,500	31	757	13.6	35	28	757	10.1	72	31	758	8.6	45	19	756	14.0	47	31	759	11.9	70	27	761	9.4	63	31	757	15.0	19
3,000	31	713	9.4	38	28	713	7.0	70	31	713	6.5	35	19	712	11.4	40	31	715	9.5	64	27	716	7.2	56	31	713	11.8	17
4,000	31	632	2.2	44	27	631	1.4	66	30	630	1.6	34	18	632	4.6	36	31	634	4.2	59	27	634	1.8	47	31	632	5.2	17
5,000	31	557	−5.0	42	26	557	−4.3	63	30	556	−3.7	25	18	558	−2.2	34	31	560	−1.4	57	26	559	−3.8	39	31	559	−1.8	17
6,000	31	490	−11.0	42	26	489	−10.3	59	30	489	−9.7	22	17	491	−8.7	34	31	493	−6.5	50					31	492	−8.8	16
7,000	31	429	−19.0	40	26	429	−16.9	55	30	429	−16.4	26	17	431	−15.9	34	31	434	−12.4	47					31	432	−15.8	17
8,000	31	375	−26.8	40	26	375	−24.3	54	29	375	−23.5	38	17	376	−23.5	33	29	380	−19.6	47					31	377	−23.5	16
9,000	30	325	−34.9	38	26	326	−31.9	54	29	326	−31.0	32	17	327	−31.8	32	29	331	−27.2	45					31	328	−31.8	16
10,000	30	282	−43.1	----	26	282	−39.9	----	29	283	−38.5	16	17	284	−40.2	----	27	288	−34.9	44					31	284	−39.4	16
11,000	30	242	−50.5	----	25	244	−46.9	----	29	245	−45.8	----	16	245	−47.8	----	26	248	−42.5	----					31	245	−46.2	----
12,000	30	207	−55.6	----	24	209	−52.5	----	29	210	−53.2	----	15	210	−53.2	----	26	214	−49.9	----					30	210	−51.8	----
13,000	30	177	−57.3	----	23	178	−57.0	----	29	179	−58.7	----	15	180	−56.7	----	26	184	−56.9	----					30	180	−56.5	----
14,000	30	151	−59.0	----	23	152	−60.4	----	29	153	−62.4	----	15	153	−59.2	----	26	156	−63.0	----					30	154	−60.9	----
15,000	29	129	−59.9	----	22	130	−62.3	----	29	130	−64.5	----	15	130	−61.7	----	25	133	−66.8	----					28	131	−64.1	----
16,000	28	110	−60.0	----	21	110	−62.5	----	28	111	−64.4	----	14	111	−63.7	----	25	112	−68.4	----					26	111	−65.7	----
17,000	26	94	−58.8	----	20	93	−61.7	----	27	95	−62.9	----	14	94	−63.1	----	21	95	−67.1	----					24	94	−64.7	----
18,000	23	80	−57.3	----	18	79	−60.0	----	24	81	−60.8	----	14	80	−61.5	----	20	80	−64.6	----					22	80	−62.5	----
19,000	16	68	−55.5	----	17	68	−57.7	----	23	68	−58.4	----	12	69	−59.7	----	17	68	−61.6	----					21	68	−59.7	----
20,000	10	58	−53.7	----	11	57	−55.7	----	9	57	−56.2	----	8	58	−57.9	----	14	58	−59.0	----					19	57	−57.3	----
21,000	6	49	−52.4	----	8	49	−54.2	----	6	48	−54.3	----	6	50	−56.5	----	9	50	−56.8	----					11	49	−54.8	----
22,000																									5	42	−53.3	----

See footnotes at end of table.

TABLE 1.—*Mean free-air barometric pressure in millibars, temperature in degrees Centigrade, and relative humidities in percent, obtained by airplanes and radiosondes during August 1940*—Continued

Altitude (meters) m. s. l.	Stations and elevations in meters above sea level																							
	Oklahoma City, Okla. (391 m.)				Omaha, Nebr. (301 m.)				Pearl Harbor, T. H.[1 2] (6 m.)				Pensacola, Fla.[1 2] (24 m.)				Phoenix, Ariz. (339 m.)				San Diego, Calif.[1] (19 m.)				Sault Ste. Marie, Mich. (221 m.)			
	Number of obs.	P.	T.	R. H.	Number of obs.	P.	T.	R. H.	Number of obs.	P.	T.	R. H.	Number of obs.	P.	T.	R. H.	Number of obs.	P.	T.	R. H.	Number of obs.	P.	T.	R. H.	Number of obs.	P.	T.	R. H.
Surface	31	970	22.7	77	31	981	20.5	82	31	1,014	24.6	81	31	1,015	24.5	89	31	970	30.6	40	20	1,011	19.2	83	31	992	14.9	89
500	31	958	23.5	70	31	958	20.6	75	31	959	22.0	84	31	960	24.1	77	31	953	32.8	36	20	957	18.0	74	31	960	16.1	75
1,000	31	904	22.4	63	31	905	19.2	69	31	905	19.1	90	31	906	21.0	79	31	902	30.9	34	20	903	23.3	36	31	906	14.5	71
1,500	31	854	19.3	64	31	853	16.8	66	31	854	16.4	86	31	855	18.0	78	31	852	27.3	36	20	853	23.8	27	31	853	11.5	72
2,000	31	805	16.5	62	31	804	13.9	64	31	805	14.9	71	31	806	15.2	74	31	805	23.1	40	20	804	21.4	28	31	803	8.8	71
2,500	31	759	13.9	61	31	758	10.9	62	31	759	13.1	52	31	760	12.5	65	31	760	18.8	47	20	758	18.0	26	31	756	6.2	68
3,000	31	715	10.8	63	31	714	8.3	61	31	715	10.8	41	31	716	9.7	58	31	717	15.0	52	15	716	14.3	29	31	711	3.5	66
4,000	31	674	4.3	65	31	632	2.1	61	31	633	5.1	33	31	634	3.7	53	31	636	7.7	61	12	635	6.7	32	30	628	−1.6	60
5,000	31	560	−1.6	59	30	558	−3.9	55					22	561	−2.6	56	31	563	0.8	63	12	561	−0.7	27	30	553	−7.1	57
6,000	30	493	−7.5	51	30	490	−9.5	48					7	494	−8.4	52	31	496	−5.6	62	12	495	−7.0	20	29	486	−13.5	54
7,000	30	433	−13.5	47	29	430	−15.7	44					7	434	−14.4	50	31	436	−12.0	54	12	435	−13.5	15	28	426	−20.2	50
8,000	30	379	−20.9	46	29	376	−22.7	43					7	381	−21.0		31	382	−18.9	47	12	380	−20.7		28	370	−27.5	50
9,000	29	330	−28.1	44	29	327	−30.4	41					6	332	−28.7		31	333	−26.6	44	12	331	−28.5		27	322	−34.6	47
10,000	29	287	−35.9	42	29	284	−38.1	41					6	288	−36.6		29	290	−34.3	42	11	288	−35.6		27	279	−41.6	
11,000	29	248	−43.7		28	245	−45.0						6	249	−44.6		29	251	−42.1		11	249	−43.1		27	240	−47.4	
12,000	29	213	−51.1		28	211	−51.1						6	214	−53.2		29	216	−49.8		11	213	−50.6		27	206	−52.0	
13,000	29	182	−57.6		28	181	−55.7										29	185	−56.9		9	185	−59.0		26	176	−55.4	
14,000	27	155	−63.0		26	154	−59.3										29	158	−62.8		8	157	−63.5		25	151	−57.3	
15,000	25	132	−67.1		24	131	−61.4										28	134	−67.2		7	133	−68.4		25	128	−58.4	
16,000	24	112	−69.0		24	112	−62.3										27	113	−68.8		7	113	−69.9		25	110	−58.6	
17,000	22	95	−68.0		21	95	−62.2										21	96	−68.7		6	96	−66.7		21	94	−57.4	
18,000	19	80	−65.3		19	81	−60.6										19	81	−66.3						16	80	−55.8	
19,000	18	68	−62.6		16	69	−68.0										11	69	−62.4						13	68	−54.2	
20,000	14	58	−59.6		9	59	−55.5										6	58	−59.4									
21,000	7	49	−58.3														5	50	−57.3									

Altitude (meters) m. s. l.	Stations and elevations in meters above sea level																				Late report July 1940			
	Seattle, Wash.[1] (27 m.)				St. Thomas, V. I.[1 2] (8 m.)				Washington, D. C.[1] (7 m.)				Atlantic Station No. 1[3] (5 m.)				Atlantic Station No. 2[4] (5 m.)				Portland, Maine (19 m.)			
	Number of obs.	P.	T.	R. H.	Number of obs.	P.	T.	R. H.	Number of obs.	P.	T.	R. H.	Number of obs.	P.	T.	R. H.	Number of obs.	P.	T.	R. H.	Number of obs.	P.	T.	R. H.
Surface	31	1,014	17.5	73	30	1,016	28.4	79	18	1,019	21.2	87					30	1,023	23.5	85	13	1,014	15.0	92
500	31	960	16.6	62	30	961	22.6	96	18	961	19.1	76					30	966	19.4	86	13	959	17.9	65
1,000	31	905	14.4	58	30	907	19.4	87	18	907	16.6	76					30	912	16.3	81	13	905	14.4	65
1,500	31	853	12.1	55	30	855	16.8	79	18	855	14.5	73					30	860	14.0	77	13	852	10.7	70
2,000	31	803	9.5	56	30	806	14.8	64	18	806	12.4	67					29	810	11.6	74	13	803	6.8	74
2,500	31	756	7.1	52	30	760	12.5	55	18	758	10.2	60					29	762	9.0	65	13	755	4.3	74
3,000	31	711	4.8	38	30	716	9.8	51	18	714	8.4	48					29	718	6.7	61	12	710	1.4	75
4,000	31	628	−.3	30	30	634	3.7	49	18	632	3.3	40					29	635	1.3	52	12	626	−4.6	69
5,000	30	553	−6.3	33					18	558	−2.4	34					27	560	−4.1	49	12	551	−10.6	60
6,000	29	486	−12.8	35					18	491	−8.4	37					27	493	−9.8	50	12	483	−17.4	54
7,000	27	426	−19.8	36					18	432	−14.6	41					27	433	−16.0	48	12	422	−24.8	52
8,000	26	372	−27.2	34					10	378	−21.3						27	378	−22.9	47	12	367	−32.2	51
9,000	22	322	−34.9	35					10	329	−28.5						27	329	−30.5	48	12	318	−40.1	
10,000	19	279	−42.4						10	286	−35.8						27	285	−38.3	50	12	274	−45.9	
11,000	16	240	−49.2						8	246	−43.3						25	246	−46.2		12	238	−50.7	
12,000	13	206	−54.4						8	212	−50.6						25	211	−53.9		12	202	−54.6	
13,000	10	176	−56.7						8	182	−56.6						25	180	−59.9		12	173	−56.3	
14,000	6	151	−58.0						5	155	−61.4						24	154	−62.6		12	147	−55.6	
15,000	6	128	−59.0						5	132	−65.0						24	130	−62.6		12	126	−56.5	
16,000																	23	111	−61.9		11	108	−56.5	
17,000																	21	94	−60.4		8	92	−55.9	
18,000																	16	80	−58.5		8	79	−55.2	
19,000																	9	68	−57.0					

[1] U. S. Navy.
[2] Airplane observations.
[3] In or near the 5° square:
Lat. 35°00′ N. to 40°00′ N.
Long. 55°00′ W. to 60°00′ W.
[4] In or near the 5° square:
Lat. 40°00′ N. to 45°00′ N.
Long. 40°00′ W. to 45°00′ W.
[5] Airplane observations and radiosondes.

NOTE.—All observations taken at 12:30 a. m. 75th meridian time, except those at Washington, D. C., and Lakehurst, N. J., where they are taken before 5 a. m., 75th meridian time. At Norfolk, Va., observations are taken at about 6 a. m., and at Pearl Harbor, T. H., after sunrise.

None of the means included in this table are based on less than 15 surface or 5 standard level observations.

Number of observations refers to pressure only, as temperature and humidity data are missing for some observations at certain levels; also, the humidity data are not used in daily observations when the temperature is below −40.0° C.

TABLE 2.—*Free-air resultant winds based on pilot balloon observations made near 5 p. m. (75th meridian time) during August 1940. Directions given in degrees from North (N=360°, E=90°, S=180°, W=270°)—Velocities in meters per second*

Altitude (meters) m. s. l.	Abilene, Tex. (537 m.)			Albuquerque, N. Mex. (1,630 m.)			Atlanta, Ga. (299 m.)			Billings, Mont. (1,095 m.)			Bismarck, N. Dak. (512 m.)			Boise, Idaho (870 m.)			Brownsville, Tex. (7 m.)			Buffalo, N. Y. (220 m.)			Burlington, Vt. (132 m.)			Charleston, S. C. (18 m.)			Chicago, Ill. (192 m.)			Cincinnati, Ohio (157 m.)			Denver, Colo. (1,627 m.)		
	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity
Surface	31	127	1.9	29	264	0.5	30	51	1.1	31	74	1.3	31	70	0.7	31	310	4.6	31	136	5.9	31	79	0.9	31	207	1.3	29	105	1.4	31	46	0.7	31	108	0.6	31	7	1.5
500							30	26	1.2										31	138	6.3	31	141	.7	31	219	3.0	29	112	2.8	31	86	1.7	31	155	1.2			
1,000	31	128	1.7				30	38	1.1				31	95	.2	31	312	4.6	31	153	4.2	30	218	1.9	30	231	2.3	28	86	1.8	29	198	2.3	31	180	1.6			
1,500	31	149	1.4				30	33	.3	31	67	1.8	28	249	.6	31	324	5.7	30	159	2.7	28	235	2.4	29	252	3.4	27	68	.7	28	226	3.0	30	210	1.6			
2,000	31	157	1.0	29	266	1.3	29	285	.8	31	62	.7	27	271	2.4	31	309	3.0	28	169	1.7	27	236	2.4	28	266	4.6	25	289	1.3	27	234	4.4	27	217	2.3	31	355	2.3
2,500	29	200	1.2	29	245	.6	25	286	2.3	31	303	1.2	26	293	2.8	31	282	3.8	25	179	1.1	24	267	3.9	24	270	4.8	23	307	1.9	24	248	4.9	24	237	2.6	31	8	1.6
3,000	28	264	1.1	29	272	1.3	25	267	3.0	31	282	3.4	25	284	5.5	31	260	5.0	24	177	1.7	21	280	3.8	20	264	3.7	17	284	2.2	22	266	5.3	21	222	2.1	31	9	1.4
4,000	20	295	2.4	29	325	2.6	21	282	3.1	31	271	7.7	21	299	7.6	31	249	7.1	24	210	1.4	18	283	4.9	18	286	5.5	12	276	1.4	17	264	5.2	16	206	1.7	31	333	4.5
5,000	15	308	4.1	28	324	3.8	20	283	4.1	30	274	9.7	19	300	8.0	31	247	9.2	21	187	.7	13	297	5.9	15	298	7.2	10	326	3.3	14	275	7.0	10	271	1.7	26	320	5.5
6,000	14	289	5.6	24	319	3.9	17	294	3.7	29	289	10.7	18	304	8.2	31	243	9.4	19	166	.4	11	290	6.5	10	298	8.3				11	272	8.9				19	320	7.1
8,000	12	291	6.9	21	289	5.6	14	270	5.7	25	281	12.2	13	298	10.4	26	243	9.1	14	351	1.1										11	264	11.7				13	325	9.2
10,000	11	293	7.9	20	285	10.0	11	289	5.6	21	285	15.2	10	304	12.3	21	249	10.0	12	39	4.9																11	329	7.5
12,000	10	300	10.0	15	297	11.5				14	281	16.8				15	256	14.5																					
14,000				13	274	8.5										10	256	15.4																					
16,000				13	284	5.4																																	

Altitude (meters) m. s. l.	El Paso, Tex. (1,196 m.)			Ely, Nev. (1,910 m.)			Grand Junction, Colo. (1,413 m.)			Greensboro, N. C. (271 m.)			Havre, Mont. (766 m.)			Jacksonville, Fla. (14 m.)			Las Vegas, Nev. (570 m.)			Little Rock, Ark. (79 m.)			Medford, Oreg. (410 m.)			Miami, Fla. (10 m.)			Minneapolis, Minn. (261 m.)			Mobile, Ala. (10 m.)			Nashville, Tenn. (194 m.)		
	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity
Surface	31	178	1.3	31	221	1.9	31	352	1.5	24	37	1.6	31	271	0.4	28	114	2.5	31	162	3.5	30	152	1.7	31	306	1.5	31	112	1.8	31	92	0.9	31	170	2.0	31	10	0.9
500										24	44	1.8				27	141	2.5				30	146	1.3	31	312	2.2	31	136	1.4	31	114	1.0	31	190	2.1	31	26	.8
1,000										24	94	1.1	31	269	.9	24	220	1.7	31	174	3.8	29	166	.8	31	330	2.1	31	177	.6	26	256	.6	30	123	.8	31	19	.9
1,500	31	188	1.4				31	347	1.7	23	196	.3	31	216	1.8	22	269	1.9	31	184	3.7	27	161	.3	31	284	1.7	31	226	.5	24	239	1.4	29	9	.9	31	350	.4
2,000	31	156	.9	31	216	2.4	31	331	1.7	22	276	1.3	31	234	1.5	23	290	2.3	31	195	4.1	27	144	.7	31	209	2.2	31	221	1.0	18	251	1.5	27	345	.9	31	305	.5
2,500	31	123	1.2	31	216	2.8	31	286	2.0	19	297	3.2	31	230	4.6	22	296	2.5	31	207	4.3	23	154	1.1	31	199	3.3	31	225	1.0	17	298	1.9	26	348	.6	25	264	1.7
3,000	31	94	1.9	31	224	3.1	31	288	3.1	19	285	5.0	30	237	6.9	21	295	2.6	31	205	5.2	15	133	1.1	31	210	4.5	30	216	1.3	14	272	3.5	25	292	.8	21	267	1.9
4,000	28	52	1.3	30	222	3.6	31	292	3.3	14	274	5.2	25	257	9.1	19	267	1.9	30	214	5.3	14	118	.6	30	218	5.4	24	242	1.6	10	257	4.8	20	238	2.9	10	291	4.2
5,000	24	30	1.7	27	217	4.8	28	295	4.1	12	286	6.0	24	267	12.3	19	270	2.1	28	215	3.7	10	296	4.0	30	231	6.8	22	181	1.2				18	242	3.5			
6,000	21	22	2.5	22	226	6.1	24	290	3.6				19	269	12.2	16	290	2.2	27	221	3.5				30	233	7.3	18	117	1.6				15	243	4.0			
8,000	14	267	1.3	15	249	7.3	10	274	6.4							17	311	2.1	26	238	4.9				30	241	9.8	13	79	2.0									
10,000				10	265	14.5										12	329	4.5	23	259	8.1				28	237	12.6												
12,000																10	323	10.8	23	258	11.6				25	234	13.8												
14,000																			21	274	10.1				19	246	19.7												
16,000																			20	253	3.4				10	251	13.7												
18,000																			16	118	2.0																		

Altitude (meters) m. s. l.	New York, N. Y. (15 m.)			Oakland, Calif (8 m.)			Oklahoma City, Okla. (402 m.)			Omaha, Nebr. (306 m.)			Phoenix, Ariz. (344 m.)			Rapid City, S. Dak. (982 m.)			St. Louis, Mo. (181 m.)			San Antonio, Tex. (183 m.)			San Diego, Calif. (15 m.)			Sault Ste. Marie, Mich. (230 m.)			Seattle, Wash. (14 m.)			Spokane, Wash. (603 m.)			Washington, D. C. (10 m.)		
	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity
Surface	29	147	1.6	31	281	5.0	31	158	2.2	31	147	1.4	31	238	1.5	31	116	1.9	30	213	1.2	31	119	1.7	31	266	3.9	30	199	1.0	31	292	2.0	31	241	2.8	29	90	1.2
500	29	162	2.0	30	269	3.0	31	162	2.7	31	145	1.7	31	236	1.9				30	222	1.1	31	116	2.0	31	288	2.2	30	177	1.2	31	312	1.3				29	113	2.5
1,000	27	225	.4	29	222	3.1	31	164	2.4	31	194	1.8	31	247	2.3	31	116	1.9	29	201	1.3	31	118	1.7	30	303	2.6	29	222	1.4	26	290	1.4	31	237	3.4	25	150	2.3
1,500	25	268	1.9	29	200	3.3	30	167	2.1	30	220	2.8	31	240	2.3	31	137	1.2	28	199	2.6	31	127	1.7	30	296	2.0	28	241	2.1	24	291	.7	31	243	3.0	19	222	2.2
2,000	20	286	2.9	29	193	3.6	29	204	1.6	30	247	4.0	31	228	2.0	31	161	.8	28	219	3.0	29	135	.8	30	242	1.4	28	259	2.4	22	237	2.2	30	226	2.9	16	257	3.1
2,500	17	299	5.1	29	181	3.7	27	275	1.9	28	275	5.0	31	213	1.2	30	240	1.1	24	265	3.8	27	154	.8	30	199	1.6	24	265	2.6	19	230	2.7	29	235	4.4	16	254	4.1
3,000	13	278	5.3	29	186	3.6	26	292	2.7	27	281	5.6	31	231	.5	29	288	4.5	22	283	4.8	25	302	.4	29	180	2.5	22	276	3.9	17	239	2.9	29	238	6.0	16	257	4.7
4,000				29	201	5.0	22	324	3.7	24	290	7.6	31	67	1.7	28	305	6.5	19	281	5.9	24	299	1.5	26	181	3.3	16	265	5.9	16	249	4.6	29	247	9.0	14	289	6.2
5,000				29	201	5.4	20	316	5.7	20	292	9.8	30	89	1.7	23	309	7.8	16	286	6.5	20	313	1.5	24	196	3.3	15	262	5.7	15	255	6.1	26	251	12.0	12	259	5.5
6,000				27	210	5.9	16	298	5.7	18	293	10.1	28	76	.5	22	303	10.0	14	275	6.2	20	313	3.3	20	219	3.5	12	262	5.3	15	254	8.7	25	252	13.5	12	284	8.1
8,000				26	210	7.8	10	286	6.7	10	287	13.4	26	292	1.4	15	314	11.9				17	327	1.5	11	240	4.6							23	259	16.2	10	265	8.4
10,000				22	233	12.5							22	272	5.0	13	308	13.9				14	360	2.7										17	266	17.0			
12,000				18	248	13.4							20	270	9.8	13	308	15.9																13	270	21.1			
14,000				13	238	17.0							13	288	5.3	12	294	11.6																					
16,000													10	157	1.4	10	275	7.6																					

TABLE 3.—*Maximum free air wind velocities (m. p. s.), for different sections of the United States, based on pilot-balloon observations during August 1940*

Section	Surface to 2,500 meters (m. s. l.)					Between 2,500 and 5,000 meters (m. s. l.)					Above 5,000 meters (m. s. l.)				
	Maximum velocity	Direction	Altitude (m.) m. s. l.	Date	Station	Maximum velocity	Direction	Altitude (m.) m. s. l.	Date	Station	Maximum velocity	Direction	Altitude (m.) m. s. l.	Date	Station
Northeast [1]	24.1	WNW	1,000	25	Caribou, Maine	37.1	SSW	3,260	24	Elmira, N. Y.	45.2	WNW	16,200	15	Albany, N. Y.
East-Central [2]	31.1	ESE	2,370	12	Knoxville, Tenn.	28.8	ESE	2,501	12	Knoxville, Tenn.	44.0	W	16,840	4	Nashville, Tenn.
Southeast [3]	27.4	E	1,000	11	Spartansburg, S. C.	21.7	E	2,501	11	Spartansburg, S. C.	47.0	ENE	33,482	31	Miami, Fla.
North-Central [4]	39.0	NNW	1,260	15	Minneapolis, Minn.	36.6	NW	4,600	24	Alpena, Mich.	53.6	W	9,540	5	Huron, S. Dak.
Central [5]	30.9	SW	1,580	24	Dodge City, Kans.	33.2	SW	3,220	26	Wichita, Kans.	42.0	WNW	12,340	6	Omaha, Nebr.
South-Central [6]	35.0	SSW	1,900	3	Amarillo, Tex.	23.2	SW	3,910	27	Oklahoma City, Okla.	35.0	WNW	9,510	27	Big Spring, Tex.
Northwest [7]	33.0	NW	1,143	9	Ellensburg, Wash.	37.2	SW	3,556	31	Havre, Mont.	45.6	SW	7,820	1	Ellensburg, Wash.
West-Central [8]	42.0	NNW	2,240	7	Casper, Wyo.	26.5	NNW	2,501	10	Cheyenne, Wyo.	47.8	W	11,395	3	Rock Springs, Wyo.
Southwest [9]	22.8	E	2,000	18	El Paso, Tex.	26.4	E	2,910	18	El Paso, Tex.	46.5	W	13,120	26	Phoenix, Ariz.

[1] Maine, Vermont, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania and Northern Ohio.
[2] Delaware, Maryland, Virginia, West Virginia, Southern Ohio, Kentucky, Eastern Tennessee and North Carolina.
[3] South Carolina, Georgia, Florida and Alabama.
[4] Michigan, Wisconsin, Minnesota, North Dakota and South Dakota.
[5] Indiana, Illinois, Iowa, Nebraska, Kansas and Missouri.
[6] Mississippi, Arkansas, Louisiana, Oklahoma, Texas (except extreme West Texas) and Western Tennessee.
[7] Montana, Idaho, Washington and Oregon.
[8] Wyoming, Colorado, Utah, Northern Nevada and Northern California.
[9] Southern California, Southern Nevada, Arizona, New Mexico, and extreme West Texas.

TABLE 4.—*Mean altitudes and temperatures of significant points identifiable as tropopauses during August 1940, classified according to the potential temperatures (10° intervals between 290° and 409° A.) with which they are identified (based on radiosonde observations)*

Potential temperatures, °A.	Bismarck, N. Dak.			Brownsville, Tex.			Charleston, S. C.			Denver, Colo.			Ely, Nev.			El Paso, Tex.			Great Falls, Mont.		
	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature °C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature °C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature °C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature °C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature °C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature °C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature °C.
290–299																					
300–309																					
310–319																					
320–329	7	9.0	−36.1							1	9.0	−36.0	2	9.7	−42.0				11	9.8	−44.1
330–339	23	10.7	−47.6	1	11.8	−56.0	2	11.8	−57.5	15	10.6	−44.7	12	10.5	−44.3	3	9.8	−37.3	32	11.2	−52.3
340–349	18	11.9	−53.1	12	11.8	−48.8	14	12.3	−54.6	17	11.9	−51.8	29	11.8	−51.2	18	12.1	−51.8	14	12.3	−57.6
350–359	13	13.0	−57.3	14	13.3	−57.7	18	13.7	−62.9	8	13.5	−61.8	12	13.4	−60.2	11	13.8	−62.5	2	13.8	−62.5
360–369	4	13.8	−58.8	13	15.0	−67.8	10	14.8	−67.5	15	14.4	−63.5	16	14.4	−63.9	13	14.7	−67.3	8	14.1	−61.5
370–379	5	14.7	−61.2	10	16.0	−72.7	6	15.5	−69.2	5	15.5	−68.0	16	15.2	−65.6	9	15.7	−69.8	4	14.3	−59.5
380–389	9	15.0	−60.1	8	16.4	−71.9	5	16.3	−71.2	8	15.8	−65.2	6	15.6	−65.5	2	16.4	−71.0	5	15.0	−61.2
390–399	1	15.4	−58.0	4	16.9	−72.0	3	16.5	−69.0	2	16.2	−65.0	6	16.0	−63.8	4	16.8	−70.8	4	15.8	−62.0
400–409	5	15.9	−57.8	1	17.2	−69.0				2	16.6	−65.0	2	16.4	−63.0	5	17.1	−68.2	3	16.0	−61.7
Weighted means		12.4	−52.7		14.5	−63.3		14.0	−63.2		13.2	−56.9		13.3	−57.4		14.1	−61.6		12.3	−54.9
Mean potential temperature °A. (weighted)	352.0			365.0			359.0			356.6			358.5			363.4			348.7		
No. days with observations	27			23			22			23			29			20			30		

Potential temperatures °A.	Joliet, Ill.			Lakehurst, N. J.			Medford, Oreg.			Nashville, Tenn.			Oakland, Calif.			Oklahoma City, Okla.			Omaha, Nebr.		
	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature °C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature °C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature °C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature °C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature °C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature °C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature °C.
290–299																					
300–309																					
310–319	2	10.6	−57.5																		
320–329	4	9.7	−44.5	3	9.2	−40.3	1	10.7	−53.0	1	8.7	−34.0	3	9.4	−44.3				5	9.4	−43.6
330–339	8	10.7	−47.5	9	10.5	−46.2	9	10.8	−48.2	5	10.7	−47.8	18	10.4	−44.8	10	10.2	−41.0	11	10.2	−43.0
340–349	11	11.8	−52.3	24	12.4	−57.0	14	12.3	−55.9	8	12.7	−58.4	19	11.7	−50.2	21	12.2	−55.0	19	12.0	−52.2
350–359	10	13.3	−59.7	7	13.2	−59.6	3	12.6	−56.0	17	13.6	−61.9	8	13.3	−59.2	11	13.4	−60.6	9	13.3	−59.7
360–369	12	14.3	−63.0	8	14.3	−63.9	2	13.7	−59.0	12	14.6	−66.9	11	14.3	−63.2	17	14.7	−66.8	9	14.2	−61.7
370–379	4	15.1	−64.2	6	14.7	−65.5	3	14.9	−64.0	8	15.6	−68.4	11	15.3	−67.3	8	15.6	−70.4	7	14.6	−61.4
380–389	8	15.4	−63.9	8	15.6	−65.5	7	15.6	−64.6	5	16.1	−70.4	4	15.8	−67.8	7	16.0	−68.7	6	15.3	−61.2
390–399	1	16.5	−65.0	3	16.1	−65.3	3	15.8	−62.7	7	16.3	−67.6	8	16.1	−67.0	4	16.6	−68.8	7	16.1	−63.9
400–409	1	16.2	−60.0	1	16.5	−66.0	3	16.5	−63.3	3	17.0	−67.7	5	16.5	−64.2	1	17.3	−70.0	3	16.3	−62.7
Weighted means		13.1	−57.3		13.1	−58.1		13.3	−57.3		14.3	−63.2		13.1	−56.7		13.6	−60.2		13.0	−55.4
Mean potential temperature °A. (weighted)	355.7			355.7			359.4			363.8			358.2			358.6			358.3		
No days with observations	24			29			15			25			28			24			25		

TABLE 4.—*Mean altitudes and temperatures of significant points identifiable as tropopauses during August 1940, classified according to the potential temperatures (10° intervals between 290° and 409° A) with which they are identified (based on radiosonde observations)*—Continued

Potential temperatures °A.	Phoenix, Ariz.			Sault Ste. Marie, Mich.			Atlantic Sta. No. 2 [2]		
	Number of cases	Mean altitude (km.) m.s.l.	Mean temperature °C.	Number of cases	Mean altitude (km.) m.s.l.	Mean temperature °C.	Number of cases	Mean altitude (km.) m.s.l.	Mean temperature °C.
290–299									
300–309				1	7.3	−37.0			
310–319				3	8.7	−44.0	1	8.7	−45.0
320–329				10	10.0	−49.5	1	9.7	−49.0
330–339	5	11.6	−56.0	13	10.9	−51.0	7	11.5	−53.7
340–349	14	12.1	−51.4	10	12.1	−54.8	26	12.5	−57.5
350–359	15	13.7	−61.6	12	13.0	−57.2	11	13.5	−61.6
360–369	20	14.8	−67.6	5	14.1	−62.6	7	14.5	−65.4
370–379	9	15.4	−68.2	6	14.0	−57.7	5	15.0	−64.8
380–389	6	16.4	−72.2	9	15.0	−60.3	1	15.6	−61.0
390–399	9	16.7	−69.9	3	16.2	−63.0	3	15.9	−66.3
400–409									
Weighted means		14.3	−63.5		12.4	−54.9		13.1	−59.4
Mean potential temperature °A. (weighted)		362.9			350.5			351.4	
No. days with observations		28			26			25	

[2] In or near the 5° square, lat. 40°00′N. to 45°00′N., long. 40°00′W. to 45°00′W.

WEATHER ON THE NORTH ATLANTIC OCEAN

By H. C. HUNTER

Atmospheric pressure.—The pressure was above normal, on the average, over most parts of the North Atlantic area which are covered by available reports. The excess was noteworthy over the west-central portion, where the Nantucket station reported a positive departure of 5.1 millibars (0.15 inch). The north-central West Indies region and the northern part of the Gulf of Mexico had pressure somewhat below normal.

The extremes of pressure in the vessel reports now at hand were 1,032.5 and 993.2 millibars (30.49 and 29.33 inches, respectively). The high mark was recorded on the American liner *Extavia*, near 40° N., 27° W., during the forenoon of the 5th. The low mark was noted not quite 100 miles to east-southeastward of Charleston, S. C., very early on the 11th, by the American steamship *Tydolgas*, which was then in the north semicircle of the second of the August tropical disturbances.

In some land areas affected by the first or the second of these cyclones it is noteworthy that stations near the coast recorded much lower readings than that of the *Tydolgas*, the lowest of these shore readings being 974.7 millibars (28.78 inches) at Savannah on the 11th.

TABLE 1.—*Averages, departures, and extremes of atmospheric pressure (sea level) at selected stations for the North Atlantic Ocean and its shores, August 1940*

Station	Average pressure	Departure from normal	Highest	Date	Lowest	Date
	Millibars	*Millibars*	*Millibars*		*Millibars*	
Lisbon, Portugal	1,018.5	+1.9	1,023	17	1,011	20
Horta, Azores	1,023.8	+0.9	1,030	9	1,015	25, 26
Belle Isle, Newfoundland [1]	1,014.0	+1.8	1,029	23	999	26
Halifax, Nova Scotia [3]			1,032	30	1,010	20, 21
Nantucket	1,020.7	+5.1	1,031	11	1,004	20
Hatteras	1,017.3	+1.4	1,024	12	1,005	19
Turks Island	1,015.6	−1.7	1,017	[2] 2	1,010	6
Key West	1,015.2	0.0	1,019	30	1,012	20
New Orleans	1,014.6	−0.6	1,020	31	1,006	6

[1] For 24 days.
[2] For 20 days.
[3] Also 5 later dates.

NOTE.—All data based on available observations, departures compiled from best available normals related to time of observation, except Hatteras, Key West, Nantucket, and New Orleans, which are 24-hour corrected means.

For those portions of the North Atlantic remote from the tropics the lowest reading found was 997.3 millibars (29.45 inches), noted on the United States Army transport *American Legion*, near the coast of northwestern Norway on the morning of the 18th.

Cyclones and gales.—On the ocean areas north of the 34th parallel of latitude there was little storminess worth mentioning. One occurrence of force 10 (whole gale) is indicated in the table of storms, this coming during the night of the 26th–27th at the location of the United States Coast Guard cutter *Champlain*, about 39° N.,59° W. A LOW of considerable strength for the time of year had moved east-northeastward off the coast of Labrador during the preceding day, and a narrow trough extended southward from the center to about the 35th parallel of latitude, causing strong shifting winds within a small strip.

Disturbances of the tropical region.—Three cyclones affected the North Atlantic waters within the tropics and a short distance outside during the month. The first two of these are described elsewhere in this REVIEW, but the third storm is to be described in the next succeeding issue.

The earliest of these storms formed east of Florida on the 2d or 3d and moved slowly to the coast of southwestern Louisiana by the 7th, seemingly never reaching hurricane intensity, though one vessel met a force 11 wind.

The second storm traveled northwestward from the vicinity of St. Thomas on the 5th to the coast of South Carolina on the 11th. During the final hours of its passage over water there were hurricane force winds, as noted by two vessels. The tracks of the first and second storms are indicated on an accompanying map.

The third storm, coming from the southeastward, was not far off Hatteras when the month ended.

Fog.—Reports indicate much less fog than normal, especially near New England and Nova Scotia. However, the foggiest 5° square for the entire North Atlantic ocean area was in this section, 40° to 45° N., 65° to 70° W., where fog was observed on 5 days, the normal August occurrence there being 17 days.

During the 9-day period, 9th to 17th, there was no fog in any part of the ocean that available reports were covering on those days.

OCEAN GALES AND STORMS, AUGUST 1940

Vessel	Voyage		Position at time of lowest barometer		Gale began August	Time of lowest barometer August	Gale ended August	Lowest barometer	Direction of wind when gale began	Direction and force of wind at time of lowest barometer	Direction of wind when gale ended	Direction and highest force of wind	Shifts of wind near time of lowest barometer
	From—	To—	Latitude	Longitude									
NORTH ATLANTIC OCEAN			° ′	° ′				*Millibars*					
Lysefjord, Nor. S. S	New Orleans	Cortes	26 00 N.	88 05 W.	4	4p, 4	4	1,009.6	NW	NW, 8	S	NW, 8	NW-W.
Connecticut, Am. S. S	Port Arthur	Norfolk	26 45 N.	88 06 W.	4	1a, 5	5	1,003.7	WNW	S, 11	S	S, 11	WNW-S.
Sun, Am. M. S	Westwego, La.	Marcus Hook	27 54 N.	87 42 W.	5	3a, 5	5	997.3	SSW	W, 5	S	S, 10	W-S.
Roanoke, Am. S. S	Port Arthur	Wilmington, N. C.	26 48 N.	88 12 W.	5	4a, 5	5	1,004.7	NW	W, 7	S	S, 10	W-S.
Virginia, Am. S. S	New York	Port Arthur	26 48 N.	87 18 W.	5	6a, 5	5	1,007.1	S	S, 8	S	S, 9	
Rhode Island, Am. M. S	Port Arthur	New York	27 14 N.	88 48 W.	5	2p, 5	5	1,003.4	SSW	SSW, 5	SSW	SSW, 9	W-SSW.
Pygmalion, Du. M. S	New York	Carupano	19 36 N.	65 48 W.	5	5p, 5	6	1,012.5	E	E, 8	SE	E, 9	E-SE.
Dungannon, Am. S. S	Port Neches, Tex.	Claymont, Del.	27 35 N.	89 50 W.	5	6p, 5	6	1,005.8	NE	WNW, 7	SSE	S, 10	NW-WSW.
Meton, Am. S. S	Houston	Fall River	27 30 N.	90 24 W.	5	7p, 5	6	1,005.4	N	WNW, 7	SSE	S, 10	N-WSW.
Seatrain Havana, Am. S. S.	Habana	New Orleans	28 44 N.	88 37 W.	5	4a, 6	6	1,008.5	WSW	SE, 9	S	SE, 9	SSW-SE-SSE.
Gulfqueen, Am. S. S	Wilmington, N. C.	Port Arthur	28 00 N.	90 12 W.	5	7p, 6	7	1,009.8	S	SE, 8	SE	SE, 10	None.
Amazone, Du. S. S	New York	Port au Prince	22 30 N.	74 24 W.	6	4a, 7	7	1,010.0	ENE	W, 1	WSW	ENE, 7	N-WSW.
Louisiana, Am. M. S	Providence	Port Arthur	29 00 N.	93 30 W.	6	11p, 7	7	1,004.1	SSW	SE, 4	S	SSE, 9	S-SE-SSW.
Seatrain Texas, Am. S. S.	New York	Texas City, Tex.	28 00 N.	93 30 W.	7	4a, 8	8	1,005.4	SSE	S, 8	S	S, 8	SSE-S.
Flora, Du. S. S	Curacao	New York	26 12 N.	74 06 W.	5	9a, 8	8	1,010.7	NE	ENE, 9	ENE	ENE, 9	None.
Mexican, Am. S. S	New York	Cristobal	30 50 N.	73 50 W.	8	4a, 9	10	1,008.1	ESE	SSE, 6	SW	SW, 8	SE-S.
Dungannon, Am. S. S	Port Neches, Tex.	Claymont, Del.	31 48 N.	78 12 W.	10	1a, 10	10	1,013.5		NE, 5		E, 8	NNE-E.
Meton, Am. S. S	Houston	Fall River	32 12 N.	77 42 W.	9	4a, 10	10	1,009.5	N	E, 8	ESE	E, 8	NE-E-ENE.
Maine, Am. S. S	Norfolk	Cristobal	32 00 N.	77 18 W.	10	6p, 10	11	1,005.1	E	ESE, 11	SE	ESE, 12	E-SE.
Bidwell, Am. M. S	Marcus Hook	Port Arthur	[1] 30 39 N.	77 02 W.	10	8p, 10	11	1,008.1	E	E, 8	SE	SE, 9	E-SE.
Jolee, Am. S. S	Norfolk	Houston	31 00 N.	77 00 W.	9	11p, 10	11	999.3	E	E, 10	SE	E, 10	E-ESE.
Tydolgas, Am. S S	New Orleans	New York	32 17 N.	78 29 W.	10	2a, 11	12	993.2	N	ENE, 10	SE	ESE, 12	NE-ESE.
Gulfcrest, Am. M. S	New York	Port Arthur	30 48 N.	80 30 W.	11	7a, 11	11	1,003.7		WNW, 8		WNW, 8	NW-W.
Alamo, Am. S. S	Tampa	New York	31 40 N.	77 56 W.	10	8a, 11	11	1,001.0	NW	SW, 9	SE	S, 10	NW-S.
Monterey, Am. S. S	Habana	do	31 35 N.	79 00 W.	11	9p, 11	12	1,008.1	SW	SSE, 8	SE	SSE, 9	SW-SSE.
Cayuga, U. S. C. G	On station	No. 1	39 00 N.	58 30 W.	15	8a, 15	15	1,010.2	SW	SW, 8	NNW	SW, 8	SW-N.
Steel Traveler, AM. S. S.	Cristobal	Boston	39 42 N.	69 48 W.	18	7a, 19	18	1,008.8	S	SSE, 5	SE	SE, 9	
Champlain, U. S. C. G	On station	No. 1	39 00 N.	58 48 W.	26	2a, 27	27	1,002.4	NE	SW, 9	N	SW, 10	NE-SW-WSW.
Gulfhawk, Am. M. S	New York	Las Piedras	32 20 N.	71 15 W.	30	10p, 30	31	1,009.5	ESE	ESE, 8	SE	ESE, 9	ESE-SE.
Kailua, Am. S. S	Cristobal	New York	32 45 N.	74 13 W.	31	1p, 31	31	999.0	NNW	NW, 9	W	NW, 9	NNW-W.
NORTH PACIFIC OCEAN													
Agwidale, Am. S. S	Honolulu	Balboa	15 29 N.	109 25 W.	3	2p, 3	3	[2] 1,008.5	NE	E, 7	E	E, 7	
Liberator, Am. S. S	do	do	15 38 N.	113 00 W.	3	1a, 4	4	1,005.4	NE	ESE, 8	ESE	ESE, 8	NE-ESE.
City of Alma, Am. S. S	do	do	18 14 N.	120 08 W.	5	9p, 5	6	[2] 1,008.5	NE	NNE, 8	NE	NNE, 8	
Denali, Am. S. S	Nome	Seattle	53 54 N.	161 30 W.	5	2p, 5	5	1,002.4		SW, 8		SW, 8	
W. S. Miller, Am. S. S	El Segundo	Nagaeva, U. S. S. R.	49 42 N.	146 30 W.	9	7a, 9	9	994.9	S	W, 11	WNW	W, 11	SSW-WNW.
Michigan, Am. S. S	Balboa	Los Angeles	14 20 N.	95 00 W.	20	4a, 20	20	1,009.5	N	N, 6	NE	NNE, 7	N-NNE.

[1] Position approximate.
[2] Barometer uncorrected.

WEATHER ON THE NORTH PACIFIC OCEAN

By Willis E. Hurd

Atmospheric pressure.—Barometric conditions over the North Pacific showed some extraordinarily unusual irregularities for summer, as compared with the normal, during August 1940. These conditions were peculiarly pronounced over the Gulf of Alaska and adjacent regions, and among the lower islands of Japan.

In the Gulf of Alaska pressure was exceedingly low for the month. At Kodiak the average pressure was 1,004.4 millibars (29.66 inches), the lowest of record for the month in at least the past 15 years, which is 6.8 millibars (0.20 inch) below the August normal. Lessening minus departures extended eastward to Juneau, and southward to Tatoosh Island, and in some degree westward across the entire Aleutian region. The lowest reading at Kodiak was 984 millibars (29.06 inches), on the 27th.

At the southwestern extreme of the ocean, both Naha, in the Nansei Islands, and Titijima, in the Ogasawaras, had pressures that averaged 4.4 millibars (0.13 inch) above the normal of the month.

Most central areas of the Pacific were under the influence of high pressure, unbroken except by minor lows.

Table 1.—*Averages, departures, and extremes of atmospheric pressure at sea level, North Pacific Ocean July 1940, at selected stations*

Stations	Average pressure	Departure from normal	Highest	Date	Lowest	Date
	Millibars	*Millibars*	*Millibars*		*Millibars*	
Point Barrow	1,010.5	−1.7	1,019	20, 22	999	29
Dutch Harbor	1,008.4	−2.8	1,024	10	993	2, 3
St. Paul	1,007.4	−1.1	1,023	10	990	5
Kodiak	1,004.4	−6.8	1,022	20	984	27
Juneau	1,012.5	−4.1	1,025	18	999	29
Tatoosh Island	1,018.6	+2.7	1,027	4	1,010	26
San Francisco	1,014.2	−1.0	1,020	19	1,010	22
Mazatlan	1,011.4	+0.9	1,016	3	1,007	17
Honolulu	1,014.9	−1.4	1,017	14	1,012	26
Midway Island	1,020.7	+2.1	1,024	6, 7, 25	1,015	27
Guam	1,009.2	−0.6	1,019	1	1,003	24
Manila	1,007.3	+0.2	1,012	5, 11	1,002	28, 29
Hong Kong						
Naha	1,009.8	+4.4	1,015	[1] 4	987	23
Titijima	1,012.2	+4.4	1,023	4	1,008	23
Petropavlovsk	1,009.6	−0.6	1,017	30	997	9

[1] And on other dates.

Note.—Data based on 1 daily observation only, except those for Juneau, Tatoosh Island, San Francisco, and Honolulu, which are based on 2 observations. Departures are computed from best available normals related to time of observations.

Extratropical cyclones and gales.—August, like the preceding July, appears to have been extraordinarily quiet over northern and central North Pacific waters. Unfor-

tunately, ships' reports were unusually few from the ocean's western half, but such as were received from that area gave no indication of winds stronger than force 6 or 7 in the extreme being experienced.

For the upper eastern half of the ocean, gales were reported on 2 days. The earlier, on the 5th, was of force 8, experienced by the American steamship *Denali*, near 54° N., 162° W. The latter, on the 9th, gave evidence of considerable local energy in connection with a cyclone over and south of the Gulf of Alaska. Between 7 and 8 a. m. of that date, the American steamer *W. S. Miller* enc ountered a west wind of force 11, lowest barometer 994.9 millibars (29.38 inches), in 49°42′ N., 146°30′ W.

Tropical cyclones.—Subjoined is a report by the Rev. Bernard F. Doucette, S. J., Weather Bureau, Manila, P. I., on three depressions and four typhoons that occurred over the Far East during the month.

In the southeastern Tropics a minor tropical cyclone with a rapid west-northwestward progression, is evidenced by the reports of the three following ships: The American steamer *Agwidale* met an east wind of force 7, with slightly depressed barometer, south of Acapulco on the 3d. On the 4th the steamship *Liberator* encountered an east-southeast gale of force 8, lowest barometer 1,005.4 millibars (29.69 inches), near 16° N., 113° W. On the 5th the steamship *City of Alma*, near 18° N., 120° W., ran into a north-northeast gale of force 8, with barometer at 1,008.5 millibars (29.78 inches), uncorrected.

On the 17th and 18th slightly disturbed conditions, with some fall in barometer, were observed off the lower Central American coast. These were followed by the report of a north-northeast wind of force 7 on the 20th south of the Gulf of Tehuantepec. The observations point to the existence of an incipient depression moving northwestward from a position in unusually low latitudes in these waters.

Fog.—Some 10 to 20 percent of days with fog was reported along the central and western parts of the northern steamship routes. This is much less than the normal occurrence for August, and undoubtedly the unusual lack of observations accounted, in some measure at least, for the apparent fog deficiency. Along the American coast fog was reported as follows: Off Washington on 5 days; off Oregon on 6 days; and off California on 14 days.

TYPHOONS AND DEPRESSIONS OVER THE FAR EAST

By Bernard F. Doucette, S. J.

[Weather Bureau, Manila, P. I.]

Depression, August 2–5, 1940.—A depression, apparently of minor importance, formed about halfway between the Philippines and the Mariana Islands. It moved along a north-northwesterly course, inclining to the north and northeast, thus passing about 150 miles northwest of the Bonins as a weak low-pressure area.

Depression, August 12–15, 1940.—A mild depression formed about 400 miles east-northeast of San Bernardino Strait, and moved west and west-northwest to the ocean regions about 300 miles east of northern Luzon where it disappeared. There was no evidence of intensification during the course of this disturbance.

Typhoon, August 13–18, 1940.—A weak depression was central about 60 miles east of Mindoro during the morning hours of August 13. This disturbance moved southwestward and westward, passing south of Mindoro and Culion Islands on its way to the China Sea. Moving west, then west-northwest, it proceeded toward Indochina, apparently a depression during these days. When about 120 miles southeast of Tourane, August 16, it was definitely a typhoon, small in area, but with pressure falling fast. The typhoon moved northwest, almost parallel to the coast, and disappeared over the Gulf of Tong King. Pressure values at coastal stations, Tourane to Vinh, were close to 750 mm. (999.9 mb.), August 16 to 18.

Typhoon, August 14–24, 1940.—As a low-pressure area east of Guam, this storm moved northwesterly, then westerly, apparently increasing to depression strength. On August 16, it became a typhoon, moving west and west-southwest for 1 day, reaching the 15th parallel of latitude. On August 17, it was threatening central Luzon, but a shift to the north-northwest placed northern Luzon in danger. The center entered northern Luzon late in the afternoon of August 18 north of Palanan, Isabela Province, passed between Tuguegarao and Aparri, Cagayan Province, and entered Balintang Channel north of Laoag, Ilocos Norte Province, August 19, moving west-northwest. Over the northern China Sea, the center moved close to and north of Pratas, threatening the locality of Hong Kong. It shifted to the west, however, the center passing very close to Gap Rock, after which the storm moved southwest to Hainan Island. A change to the west brought the center across the Gulf of Tong King and into the Continent about 60 miles south of Phulien, where it weakened. No trace of the storm could be found on the weather maps of August 25.

Barometric minima recorded at northern Luzon stations are listed as follows: Palanan, Isabela Province had 731.3 mm. (975.0 mb.) with northwest winds of force 9, at 5:30 p. m. of the 18th; Tuguegarao, Cagayan Province had 736.9 mm. (982.5 mb.), with west winds of force 7, at 11:05 p. m. of the 18th; Aparri, Cagayan Province had 733.9 mm. (978.5 mb.), with southeast winds force 7, at 3:45 a. m. of the 19th; Calayan, Babuyan Islands, had 742.93 mm. (990.5 mb.), with southeast winds of force 5, at 2 p. m. of the 19th; Laoag, Ilocos Norte Province had 742.9 mm. (990.5 mb.) with northwest winds of force 6, at 6:20 a. m. of the 19th. A few days later, after the storm had passed Hong Kong, the following message was received from the Royal Observatory at Hong Kong: "Barometric minimum Hong Kong Observatory, 29.215; Gap Rock, 29.07; center probably 28.8, maximum wind gust, 83 m. p. h."

Nine lives were lost as the typhoon crossed Luzon, most of these casualties occurring in central Luzon. The steamship *Nanyo Maru* was wrecked near Nagabungan, Pasugun, Ilocos Norte Province, the ship being totally destroyed, but the passengers and crew were rescued. The provinces of central Luzon had floods over large areas for a few days. No other reports of destruction were published.

The preceding typhoon, August 13–18, formed as the southwesterly current moved across the southern part of the China Sea to Zamboanga and Cebu, this taking place on August 10 and following days. Then the depression (for it apparently was not of typhoon strength as it crossed the China Sea) intensified when the circulation was able to draw upon the rather strong southwesterly current flowing over Thailand and southern Indochina. This process occurred while a disturbance over the Pacific was approaching the archipelago, and the same procedure, so it seems, took place over the southern Philippines. Velocities of the wind over Cebu and Zamboanga increased to values of 50 k. p. h. or more after August 16, Cebu usually being stronger than Zamboanga. A few days

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later, as the storm was crossing northern Luzon, velocities over 100 k. p. h. were recorded at Manila and Cebu, the directions always being from the southwest, west, or northwest quadrants at these stations. It seems to the writer that the air stream over the southern part of the archipelago was not only being attracted toward the typhoon center, but also was being impelled toward the disturbance by forces far to the southwest of the Philippines, both of these tendencies making the storm very intense. Observations from the Straits Settlements and the Netherlands East Indies are not available for confirming these impressions.

Depression, August 19–25, 1940.—A low-pressure area appeared far to the southeast of Guam, moved west, then west-northwest as a depression, and disappeared about 400 miles northeast of San Bernardino Strait. This disturbance did not manifest any signs of intensification.

Typhoon, August 20–27, 1940.—A depression appeared about 350 miles north of Yap and moved northwest, rapidly intensifying to typhoon strength. When about 120 miles south-southeast of Naha, Nansei Islands, it changed its course to the north, then later recurved to the east-northeast when it reached the regions about 120 miles west-northwest of Oshima, Nansei Islands. The storm then moved almost parallel to the coast line of Japan, entering the mainland, however, and passing west of Tokyo on its course toward the northern Pacific. By August 27, it seemed that the storm had degenerated into a mild low-pressure area, moving northeast.

When the typhoon was moving over the Eastern Sea and adjacent regions, the lowest pressure plotted on the weather map was the afternoon observation of August 23, from Naha, Nansei Islands, a value of 740.0 mm. (986.6 mb.) with northwest winds of force 6. No reports of extensive damage due to this typhoon were published.

Typhoon, August 23–September 4, 1940.—As a depression, central about 250 miles east-northeast of Guam, August 23, at 2 p. m., this storm moved west-northwest, then west, then southwest, rapidly intensifying to typhoon strength. When the center reached the 14th parallel of latitude, it again moved west, shifting to the west-northwest at longitude 134°. This brought the storm center to the eastern portion of the Balintang Channel, where it inclined to the north. The center avoided the town of Basco, Batan Islands, and continued toward Formosa. As well as could be determined, the typhoon passed over northern Formosa, moving northwesterly, and continued toward China. On August 31, the center entered China close to Foochow, and recurved to the northeast during the next 2 days. This caused the storm to pass about 150 miles west of Shanghai on its way to the Yellow Sea, Chosen (Korea), and the Sea of Japan, where it disappeared on September 4.

The minimum pressure at Basco, Batan Islands, was 740.6 mm. (987.4 mb.), at 3 a. m. August 30, with west-southwest winds of force 6. On August 31, at 2 p. m. (Manila time), Foochow reported north winds of force 10, with pressure at 734.0 mm. (978.6 mb.).

The upper winds at Guam hardly reached velocities as high as 40 k. p. h., as this storm approached the vicinity of the station, but it must be noted that the weather was unfavorable for long ascents. On August 25 velocities up to 54 k. p. h. were reported, direction south-southeast, and weakening the next day. It might be remarked that there were no strong velocities reported from this station during the whole month, when three storms passed by these ocean regions. Over the Philippines, the southwesterly air stream, quite strong as the typhoon approached, was intensified somewhat on August 28 and following days, but not to the strength manifested during the typhoon of August 14 to 24.

RIVER STAGES AND FLOODS

By Bennett Swenson

Outstanding during August were the severe floods in the rivers of southern Virginia, North Carolina, and portions of South Carolina, Georgia, and eastern Tennessee. These floods resulted from excessive precipitation accompanying the passage inland of a tropical disturbance near Savannah, Ga., on August 11. The disturbance moved slowly to the southern Appalachian Mountain region and on the 13th turned and moved slowly eastward along the North Carolina-Virginia border, passing out to sea again on the night of the 17th. (See pp. —— for a complete report on the hurricane.)

As is common with the slow movement of any disturbance where there is a strong convergent influx of warm moist air, the cumulative rainfall amounts were exceedingly high. The rainfall was heaviest over the mountains due to the extra uplift of moist air caused by the mountain slopes.

The rivers most severely affected were the James, Roanoke, Tar, New River in Virginia, Tennessee Valley above Knoxville, Tenn., and other streams rising in the eastern slope of the mountains in western North Carolina. Previous high stages of record were exceeded at a number of places. At Weldon, N. C., on the Roanoke River, a stage of 58 feet was reached on August 18, exceeding the great flood of 1877 by about 5 feet at that place.

Floods of lesser magnitude occurred in the Neuse, Cape Fear, Peedee, Santee, Savannah, and Altamaha River systems.

By reason of the difficulty in securing and preparing the necessary meteorological and hydrologic data for publication, a detailed account of these floods will be given in a later issue of the Review. The dates above flood stages and the crest stages are given in the table at the end of this report.

FLOODS IN OTHER RIVERS

East Gulf of Mexico Drainage.—Stages in the Chattahoochee and Flint Rivers remained at low stages, except in the upper portion, despite excessive rains in portions of northern and eastern Georgia. The only station reporting stages above flood was Norcross, Ga. on the Chattahoochee River, and this lasted only briefly.

The Etowah River at Cartersville, Ga. reached a stage of 19.8 feet (flood stage 18 feet) on the 14th.

The Pearl River had dropped below flood stage at the beginning of the month except at Pearl River, La. where flood stages continued until August 9.

Ohio River Basin.—In addition to the flood in the French Broad River on August 13 and 14, another occurred on August 29 to 31. The second was the more severe and was due to exceptionally heavy rainfall confined almost entirely to the headwaters of that basin. The 24-hour rainfall amounts ending at 7:30 a. m. of the 30th were 12.10 inches at Mount Mitchell and 6.78 inches at Asheville, N. C. However, the crest stage in the Tennessee River at Knoxville, Tenn. in the second rise was lower than in the first due largely to the fact that in this case the discharge of the Holston River was not as great.

The New River in Virginia and West Virginia, a tributary of the Kanawha River, which experienced unusually high stages as a result of the heavy rains accompanying the movement inland of the hurricane

mentioned previously, rose again to slightly above flood stage in the upper portion at the end of the month. A complete report of these floods will be given later.

Arkansas Basin.—A flash flood occurred in the upper North Canadian River on August 9. A total loss of $11,500 was reported.

West Gulf of Mexico drainage.—The following report has been submitted by the official in charge, New Orleans, La. regarding excessively heavy rains and floods in southwestern Louisiana on August 6 to 9:

The heaviest 4-day rainfall that has been recorded in the Southern States, as far as we are able to determine, occurred in connection with the tropical hurricane [1] that crossed the coast line with center just east of Sabine, Tex. on August 7. When the storm turned northward over extreme southeast Texas and slowed down in its forward movement from the 7th to the 9th the heaviest rainfall occurred more than 100 miles to the right of the path of the center. The rainfall was heaviest in the Crowley-Abbeville-Lafayette section in Louisiana with daily amounts as follows:

August—	Crowley [2]	Abbeville	Lafayette
6-7	4.32	4.30	1.62
7-8	9.36	8.80	4.06
8-9	19.76	17.50	19.63
9-10	.27	1.06	1.64
Total	33.71	31.66	26.95

[1] See pp. 217 for report on hurricane.
[2] Official record at Crowley not obtained because of flood conditions. Record is from Mr. F. E. Everett's gage, described as a good gage.

The 24-hour falls of 19.76 inches at Crowley and 19.63 inches at Lafayette on the 8–9th, have been exceeded in this State only by the record fall of 21.40 inches at Alexandria on June 15–16, 1886.

The water began to recede at Abbeville on the 9th after a stage of 14.32 feet, mean gulf level, was reached on the Vermillion River at the Southern Pacific railroad bridge. Crowley was largely evacuated; the water there began to fall slowly on the 10th, having reached a depth of 8 feet in some parts of the Crowley area. The flood drained slowly to the Gulf through the various streams

Colorado Basin.—Flood stages were reached at Kelvin, Ariz., on the Gila River on August 14 and 15. A flash flood occurred in the vicinity of Tucson, Ariz., during the night of August 13, following a heavy local rainfall of 2.35 inches within 70 minutes. Losses from the latter flood have been estimated at $125,000.

FLOOD-STAGE REPORT

[All dates in August unless otherwise specified]

River and station	Flood stage	Above flood stages—dates		Crest	
		From—	To—	Stage	Date
ATLANTIC SLOPE DRAINAGE					
James:	*Feet*			*Feet*	
Lynchburg, Va.	18	16	16	18.4	16
Bremo Bluff, Va.	19	15	19	33.5	17
Columbia, Va.	10	15	21	35.4	17
State Farm, Va.	12	16	20	25.6	17
Richmond, Va.	8	16	20	23.3	18
Dan:					
Danville, Va.	11	14	17	21.2	15
Clarksville, Va.	13	15	19	27.0	17
Roanoke:					
Randolph, Va.	21	15	20	[1] 41.6	16
Weldon, N. C.	31	15	23	58.0	18
Williamston, N. C.	10	18	Sept. 2	20.4	22
Fishing Creek: Enfield, N. C.	14	15	20	17.9	18
Tar:					
Rocky Mount, N. C.	8	14	20	13.2	18
Tarboro, N. C.	18	16	25	30.5	20
Greenville, N. C.	13	17	27	22.2	22

[1] Estimated.

FLOOD-STAGE REPORT—Continued

River and station	Flood stage	Above flood stages—dates		Crest	
		From—	To—	Stage	Date
ATLANTIC SLOPE DRAINAGE—continued					
Little: Kenly, N. C.	*Feet* 9			*Feet* 15.8	19
Neuse:					
Neuse, N. C.	14	15	19	16.8	16
Smithfield, N. C.	13	15	21	19.0	17
Goldsboro, N. C.	14	16	24	19.2	22
Kinston, N. C.	14	21	26	16.1	25
Cape Fear: Lock No. 2, Elizabethtown, N. C.	20	16	20	26.0	18
Pee Dee:					
Cheraw, S. C.	30	16	18	37.7	17
Mars Bluff Bridge, S. C.	17	17	25	21.1	22
Poston, S. C.	18	22	27	19.4	24–25
Saluda:					
Pelzer, S. C.	6	13	17	14.0	14
Chappells, S. C.	13	13	16	28.7	14
Catawba:					
Catawba, N. C.	8	13	17	35.0	14
Catawba, S. C.	11	14	17	24.3	16
Broad: Blairs, S. C.	14	14	17	31.6	16
Congaree: Columbia, S. C.	19	15	17	26.2	16
Wateree: Camden, S. C.	23	16	18	30.5	16
Santee:					
Rimini, S. C.	12	16	27	18.4	20
		28	30	13.0	29
Ferguson, S. C.	12	18	[2]	14.1	21–22
Broad: Carlton, Ga.	15	12	14	21.0	13
Savannah:					
Calhoun Falls, S. C.	8	13	15	10.2	13
Augusta, Ga.	32	13	16	40.9	14
Clyo, Ga.	11	17	31	23.6	21
Ogeechee:					
Midville, Ga.	6	13	20	9.9	14
Dover, Ga.	7	17	28	12.2	19
Oconee: Milledgeville, Ga.	20	13	15	23.4	14
Ohoopee: Reidsville, Ga.	17	16	18	19.6	17
Altamaha: Charlotte, Ga.	12	19	25	13.4	24
EAST GULF OF MEXICO DRAINAGE					
Chattahoochee: Norcross, Ga.	16	15	15	18.1	15
Etowah: Cartersville, Ga.	18	13	14	19.8	14
Pearl: Pearl River, La.	12	[2]	9		
MISSISSIPPI SYSTEM					
Upper Mississippi Basin					
Rock: Moline, Ill.	10	29	Sept. 1	10.3	31
Missouri Basin					
Grand: Chillicothe, Mo.	18	14	14	18.6	14
Ohio Basin					
New:					
Ivanhoe, Va.	15	13	15	32.1	14
Radford, Va.	14	14	15	34.1	14
Glenlyn, Va.	11	14	16	27.6	14
		31	31	12.1	31
Hinton, W. Va.	14	14	15	18.5	15
Kanawha: Kanawha Falls, W. Va.	25	15	15	31.7	15
North Fork: Holston: Mendota, Va.	8	14	15	15.0	14
Watauga: Elizabethton, Tenn.	14	13	14	20.9	14
Holston: Rogersville, Tenn.	13	14	16	17.7	15
Nolichucky: Embreeville, Tenn.	8	13	14	18.6	13
		30	30	11.2	30
Big Pigeon: Newport, Tenn.	6	13	15	16.0	13
		30	31	17.3	30
French Broad:					
Asheville, N. C.	6	13	16	12.5	13
		29	Sept. 2	13.2	30
Marshall, N. C.	10	13	15	13.5	14
		29	31	23.0	30
Hot Springs, N. C.	13	14	14	15.2	14
		29	31	22.3	30
Dandridge, Tenn.	12	14	16	18.7	15
		30	[2]	30.9	31
Tennessee: Knoxville, Tenn.	20	15	16	23.95	16
		31	31	20.4	31
Arkansas Basin					
North Canadian:					
Woodward, Okla.	5	8	9	6.0	9
Canton, Okla.	8	9	10	9.1	10
Yukon, Okla.	8	10	17	11.7	11

[1] Continued into next month.
[2] Continued from previous month.

CLIMATOLOGICAL DATA

[For description of tables and charts, see REVIEW, January, pp. 32 and 38]

CONDENSED CLIMATOLOGICAL SUMMARY OF TEMPERATURE AND PRECIPITATION BY SECTIONS

In the following table are given for the various sections of the climatological service of the Weather Bureau the monthly average temperature and total rainfall; the stations reporting the highest and lowest temperatures, with dates of occurrence; the stations reporting the greatest and least total precipitation; and other data as indicated by the several headings.

The mean temperature for each section, the highest and lowest temperatures, the average precipitation, and the greatest and least monthly amounts are found by using all trustworthy records available.

The mean departures from normal temperatures and precipitation are based only on records from stations that have 10 or more years of observations. Of course, the number of such records is smaller than the total number of stations.

Section	Temperature								Precipitation					
			Monthly extremes								Greatest monthly		Least monthly	
	Section average	Departure from the normal	Station	Highest	Date	Station	Lowest	Date	Section average	Departure from the normal	Station	Amount	Station	Amount
	°F.	°F.		°F.			°F.		In.	In.		In.		In.
Alabama	80.5	+0.7	Florence	102	16	Scottsboro	52	20	2.93	−1.60	Gadsden	7.13	Garden City	0.00
Arizona	79.2	+.7	4 stations	118	8	Alpine	31	[1] 27	2.26	−.08	Ruby	5.96	2 stations	.00
Arkansas	77.7	−2.4	Gravette	104	3	2 stations	45	21	4.96	+1.40	Black Rock	9.40	do	2.13
California	72.4	.0	Greenland Ranch	124	11	Portola	28	21	.01	−.09	Seven Oaks	.66	266 stations	.00
Colorado	66.2	+.6	Sedgwick	105	4	Wolf Creek Pass	20	28	1.43	−.50	La Veta Pass	4.47	Fort Lupton	.16
Florida	82.9	+1.5	3 stations	99	[1] 1	2 stations	61	[1] 22	7.18	+.10	Davie	14.45	Panama City	2.73
Georgia	79.9	+.4	do	101	[1] 1	Blairsville	51	20	7.09	+1.80	Clayton	17.74	Woodbury	1.88
Idaho	68.3	+1.9	Hazelton	113	12	2 stations	26	[1] 3	.10	−.52	Dubois	.77	20 stations	.00
Illinois	75.2	+.7	6 stations	103	[1] 1	Marengo	43	21	4.01	+.64	Oregon	10.51	Du Quoin	.75
Indiana	75.5	+1.9	Shoals	106	13	Marengo	38	22	2.74	−.61	Howe	8.47	Scottsburg	.85
Iowa	70.7	−1.4	3 stations	101	[1] 1	Decorah	39	20	6.44	+2.83	Osage	12.83	Inwood	2.36
Kansas	76.3	−1.5	Lincoln	112	1	2 stations	46	[1] 19	4.39	+1.27	Bonner Springs	12.53	Hoxie	.78
Kentucky	76.0	+.2	Henderson	102	17	3 stations	45	[1] 21	3.57	−.12	Quicksand	7.53	Uniontown	.85
Louisiana	80.2	−1.6	Winnfield	103	27	2 stations	53	[1] 21	10.83	+5.63	Lafayette	37.99	Tallulah	1.80
Maryland-Delaware	71.6	−2.0	2 stations	97	[1] 5	Sines, Md	38	21	5.38	+.81	Conowingo, Md	8.83	Unionville, Md	2.93
Michigan	67.1	+1.1	Adrain	101	13	Sidnaw	26	23	5.16	+2.47	Allegan	15.48	Channing	.40
Minnesota	66.3	−1.3	Beardsley	103	15	Meadowlands	27	23	4.51	+1.30	Winnebago	10.18	Redby	.78
Mississippi	79.7	−1.0	Leakesville	100	15	4 stations	54	[1] 21	3.84	−.37	Holly Springs	10.61	Aberdeen	.76
Missouri	75.6	−.9	Warsaw	107	1	Edgerton	45	20	5.78	+1.94	Buffalo	12.31	Chillicothe	2.25
Montana	67.6	+2.6	2 stations	109	12	Summit	25	[1] 17	.28	−.79	Ekalaka	2.16	6 stations	.00
Nebraska	73.4	+.2	do	105	[1] 1	Gordon	36	31	1.88	−.84	Virginia	12.84	Cairo	.08
Nevada	73.8	+3.1	Overton	120	11	San Jacinto	30	16	.08	−.41	Lovelock	.64	16 stations	.00
New England	65.5	−1.6	Orono, Maine	95	17	Somerset, Vt	26	25	1.88	−1.94	Norwalk, Conn	5.08	Hyannis, Mass	.39
New Jersey	69.4	−2.6	6 stations	95	6	2 stations	32	25	5.96	+1.21	Toms River	9.34	Belleplain	3.83
New Mexico	69.8	−.9	Clovis	105	4	Elizabethtown	29	[1] 29	2.45	+.03	Des Moines	6.90	Deming	.13
New York	66.5	−1.1	Jamestown	96	10	Norwich	27	24	2.68	−1.09	Scarsdale	6.71	Chazy	.19
North Carolina	75.4	−.5	4 stations	100	[1] 6	Banner Elk	41	20	10.57	+4.96	Swansboro	37.18	Monroe	3.35
North Dakota	67.8	+1.3	2 stations	103	10	2 stations	33	31	2.05	+.05	Forman	5.74	Center	.16
Ohio	72.8	+1.1	Wilmington	100	18	Mansfield	37	22	4.18	+.78	Athens	8.71	Pleasant Hill	.89
Oklahoma	79.0	−2.5	Alva	112	3	Watts	48	20	3.36	+.48	Sallisaw	9.58	Camargo	.67
Oregon	67.0	+1.6	Wallowa	107	19	Chemult	25	21	.04	−.36	Crossett	.97	82 stations	.00
Pennsylvania	68.8	−1.5	2 stations	98	[1] 6	Ridgway	30	26	4.57	+.36	2 stations	9.36	Galeton	1.91
South Carolina	78.5	−.4	do	101	1	2 stations	54	[1] 20	10.22	+4.45	Longcreek (near)	22.49	Bishopsville	3.92
South Dakota	71.1	+.2	do	107	2	do	35	[1] 18	2.24	+.13	Webster	7.47	Oelrichs	.29
Tennessee	77.1	+.4	Etowah	102	27	Gatlinburg	47	20	4.14	+.14	Kingsport	8.52	Lock A	1.24
Texas	81.4	−1.4	Seymour	112	3	4 stations	50	[1] 10	2.85	+.54	Bon Wier	19.38	Mission	.03
Utah	72.6	+2.8	St. George	112	11	2 stations	32	[1] 26	.56	−.47	Soldier Summit	3.26	2 stations	.00
Virginia	72.8	−1.3	3 stations	95	[1] 1	Burkes Garden	42	20	9.26	+4.78	Capron	17.52	Manassas	2.86
Washington	66.7	+1.0	Wawawai	108	19	Deer Park (near)	29	13	.37	−.45	Quinault	3.72	35 stations	.00
West Virginia	71.4	−.4	Inwood	98	6	Beckley fire weather station.	34	[1] 20	4.83	+.77	Rainelle	11.34	Institute	2.14
Wisconsin	66.9	−.7	3 stations	93	12	3 stations	29	23	6.10	+2.78	Brodhead	13.38	Neillsville	2.14
Wyoming	66.0	+2.0	4 stations	103	[1] 1	do	24	[1] 3	.51	−.56	Ervay	2.31	3 stations	.00
Alaska (July)	57.3	+1.8	Nenana	93	16	Barrow	29	19	1.98	−.63	Yakutat	5.48	Skagway	.22
Hawaii	76.0	+1.7	Wainae	96	12	Haleakula	37	29	13.81	+7.48	Kukui	88.00	2 stations	.00
Puerto Rico	79.5	+.9	Dos Bocas	98	26	Guineo Reservoir	59	8	5.80	−1.79	Maricao	19.98	Dorado (near)	1.08

[1] Other dates also.

Errata: MO. WEA. REV., February 1940, page 56, Puerto Rico, precipitation departure should be "+1.12".

CLIMATOLOGICAL DATA FOR WEATHER BUREAU STATIONS

District and station	Elevation of instruments: Barometer above sea level	Elevation of instruments: Thermometer above ground	Elevation of instruments: Anemometer above ground	Pressure: Station, reduced to mean of 24 hours	Pressure: Sea level, reduced to mean of 24 hours	Pressure: Departure from normal	Temperature of the air: Mean max. + mean min. ÷ 2	Temperature of the air: Departure from normal	Temperature of the air: Maximum	Temperature of the air: Date	Temperature of the air: Mean maximum	Temperature of the air: Minimum	Temperature of the air: Date	Temperature of the air: Mean minimum	Temperature of the air: Greatest daily range	Mean wet thermometer	Mean temperature of the dew-point	Mean relative humidity	Precipitation: Total	Precipitation: Departure from normal	Precipitation: Days with 0.01 inch, or more	Wind: Average hourly velocity	Wind: Prevailing direction	Wind: Maximum velocity: Miles per hour	Wind: Maximum velocity: Direction	Wind: Maximum velocity: Date	Clear days	Partly cloudy days	Cloudy days	Average cloudiness, tenths	Total snowfall	Snow, sleet, and ice on ground at end of month
	Ft.	Ft.	Ft.	In.	In.	In.	°F.	°F.	°F.		°F.	°F.		°F.	°F.	°F.	°F.	%	In.	In.		Miles								0–10	In.	In.
New England							66.3	−1.1										80	1.59	−2.0										4.1		
Eastport	75	67	85	30.02	30.10	+0.14	60.8	+0.1	81	3	70	44	25	51	29	56	53	80	2.34	−0.7	6	8.3	sw.	22	nw.	25	20	9	2	2.9	0.0	0.0
Greenville, Maine	1,070	6	----	28.97	30.13	----	61.1	----	87	16	75	34	29	47	39	58	55	--	2.09	----	8	----	----	----	----	----	----	----	----	----	.0	.0
Portland, Maine	103	82	117	29.99	30.10	+.12	65.8	−.6	85	5	73	44	25	58	25	60	57	79	1.15	−2.1	7	7.7	s.	26	s.	19	23	5	3	2.6	.0	.0
Concord	288	54	72	29.81	30.13	+.15	67.2	+.4	89	17	80	38	25	55	36	60	57	79	1.13	−2.4	10	4.8	se.	18	sw.	13	15	9	7	4.2	.0	.0
Burlington	403	11	48	29.67	30.10	+.13	66.2	−1.7	86	11	76	42	25	56	31	60	56	72	2.11	−1.3	6	7.6	s.	24	s.	30	13	9	9	4.8	.0	.0
Northfield	876	12	60	29.19	30.13	+.15	62.6	−.8	87	10	76	34	25	49	38	56	54	86	1.26	−2.3	6	6.5	sw.	21	s.	29	13	7	11	5.3	.0	.0
Boston	125	106	165	29.99	30.12	+.13	68.4	−1.5	86	17	77	46	25	60	24	61	57	72	.85	−2.8	7	9.7	sw.	25	sw.	23	15	10	6	4.5	.0	.0
Nantucket	12	14	90	30.12	30.14	+.15	66.4	−1.4	80	17	73	54	3	60	21	62	60	83	2.17	−1.2	7	12.6	sw.	29	sw.	6	13	13	5	4.6	.0	.0
Block Island	26	11	46	30.10	30.13	+.14	66.4	−2.1	79	19	72	51	25	60	18	63	60	83	1.16	−2.5	7	11.4	s.	25	nw.	23	17	8	6	3.9	.0	.0
Providence	68	65	25	29.97	30.14	+.15	69.2	−1.8	88	9	79	44	25	59	29	61	59	79	.99	−2.5	8	9.8	sw.	28	nw.	20	10	12	9	4.7	.0	.0
Hartford	159	122	----	29.96	30.12	+.13	68.0	−.9	88	10	79	38	25	57	32	62	60	82	1.79	−2.5	9	7.1	sw.	22	n.	20	8	10	13	6.1	.0	.0
New Haven	13	74	68	30.02	30.13	+.14	68.6	−1.7	86	14	77	45	25	60	26	63	61	81	2.54	−1.7	11	7.9	s.	24	nw.	23	11	8	12	5.4	.0	.0
Middle Atlantic States							71.6	−1.8										80	6.33	+2.0										6.7		N
Albany	292	26	40	30.00	30.10	+.12	67.7	−3.1	91	17	80	35	25	56	34	61	58	76	1.78	−1.9	6	7.0	s.	21	nw.	6	10	13	8	5.3	.0	.0
Binghamton	871	57	79	29.21	30.13	+.14	67.4	−.6	90	10	78	34	25	57	33	61	58	77	5.42	+1.8	9	5.1	e.	17	nw.	19	6	5	20	7.2	.0	.0
New York	314	415	454	29.78	30.11	+.11	70.4	−2.7	87	6	77	52	25	64	22	63	60	75	5.06	+.7	12	9.6	e.	38	nw.	23	7	11	13	6.3	.0	.0
Harrisburg	374	94	104	29.70	30.10	+.09	70.4	−2.2	95	6	79	50	21	62	29	64	61	79	6.22	+2.2	12	7.2	e.	26	sw.	6	4	13	14	6.8	.0	.0
Philadelphia	114	174	367	29.98	30.11	+.11	72.0	−2.8	92	6	79	53	25	65	20	66	63	81	7.87	+3.2	12	11.4	ne.	26	s.	5	4	11	16	6.8	.0	.0
Reading	323	47	306	29.76	30.11	----	70.4	−2.0	92	6	78	47	25	62	24	64	60	75	5.40	+1.2	12	9.2	se.	37	n.	6	7	11	13	6.6	.0	.0
Scranton	805	72	104	29.26	30.11	+.11	68.2	−1.6	89	9	77	38	25	59	29	61	57	71	5.13	+1.4	9	5.4	n.	25	nw.	6	7	12	12	6.1	.0	.0
Atlantic City	52	37	172	30.04	30.10	+.10	71.8	−.7	82	19	76	55	25	67	18	67	64	80	4.13	−.3	15	15.6	e.	37	e.	28	5	13	13	6.7	.0	.0
Sandy Hook	22	10	57	30.09	30.12	----	70.4	−2.1	86	6	75	56	25	65	16	65	62	80	5.63	+.6	13	12.4	s.	32	nw.	6	8	11	12	5.9	.0	.0
Trenton	190	89	107	29.91	30.11	----	70.4	−2.6	92	6	78	48	25	62	27	64	61	79	5.54	+.8	14	8.0	s.	20	n.	23	5	9	17	7.0	.0	.0
Baltimore	16	100	215	30.08	30.10	+.09	73.5	−2.0	91	6	80	56	25	67	21	67	65	80	5.60	+1.2	14	10.0	ne.	29	nw.	19	5	7	19	7.5	.0	.0
Washington	112	62	85	29.97	30.08	+.07	73.4	−1.6	91	6	80	57	26	67	20	67	64	78	5.00	+1.0	15	6.2	e.	20	nw.	19	5	9	17	7.1	.0	.0
Cape Henry	18	8	54	30.04	30.06	----	76.4	−.5	91	19	81	60	22	72	21	72	70	83	7.25	+2.4	11	12.9	se.	30	n.	19	6	19	6	5.7	.0	.0
Lynchburg	686	144	184	29.35	30.09	+.07	73.6	−2.0	93	28	81	57	23	66	29	68	66	84	9.72	+5.9	16	6.9	ne.	30	n.	28	3	10	18	7.4	.0	.0
Norfolk	91	80	125	29.97	30.07	+.07	76.8	−.6	94	19	83	64	22	71	21	71	70	85	10.14	+4.9	15	9.4	e.	28	nw.	1	1	10	20	7.7	.0	.0
Richmond	164	11	52	29.89	30.06	+.05	74.4	−2.1	91	6	82	58	21	67	23	69	68	88	11.08	+6.7	15	7.3	se.	20	nw.	6	6	8	17	6.9	.0	.0
Wytheville	2,304	49	55	----	30.07	+.06	69.2	−1.3	84	18	77	51	20	61	----	----	----	86	6.56	+2.4	18	5.2	e.	17	w.	26	1	16	14	----	.0	.0
South Atlantic States							78.9	+0.8										84	9.34	+3.7										6.3		
Asheville	2,253	89	104	27.75	30.04	+.02	72.3	+1.8	89	1	81	54	20	64	27	66	64	83	13.75	+9.6	12	7.3	nw.	26	se.	13	4	16	11	6.5	.0	.0
Charlotte	769	63	86	29.20	30.01	+.01	77.6	+.5	94	27	86	61	21	69	26	70	68	82	5.67	+.6	14	7.0	ne.	21	ne.	10	4	12	15	6.9	.0	.0
Greensboro	886	6	56	29.13	30.05	----	75.2	----	91	28	84	60	23	67	25	69	68	87	8.66	----	15	7.7	ne.	29	e.	11	4	11	16	6.8	.0	.0
Hatteras	11	5	50	30.03	30.04	+.04	78.7	+.7	88	7	83	65	23	74	16	74	72	82	9.36	+3.6	15	11.1	e.	34	s.	15	9	11	11	5.6	.0	.0
Raleigh	358	103	146	29.64	30.03	+.02	77.4	+.4	95	6	86	60	21	69	23	71	69	83	7.19	+1.8	15	8.3	ne.	29	ne.	10	2	23	6	5.9	.0	.0
Wilmington	72	73	107	29.95	30.02	+.02	79.1	+1.5	94	1	86	65	22	72	21	73	71	84	14.14	+7.8	15	8.4	s.	27	w.	15	10	9	12	6.1	.0	.0
Charleston	48	11	92	29.93	29.99	−.02	80.7	−.3	96	19	86	68	20	75	19	74	72	87	16.71	+10.2	16	1.22	se.	66	e.	11	5	13	13	6.4	.0	.0
Columbia, S. C.	225	70	91	29.64	30.00	−.01	79.6	.0	96	1	88	64	22	71	26	72	70	81	5.18	−.3	15	8.3	ne.	30	ne.	11	9	12	10	5.3	.0	.0
Greenville, S. C	1,040	70	78	28.94	30.02	----	77.8	+2.0	94	1	86	63	22	69	25	----	----	----	9.23	+3.7	10	7.2	ne.	28	s.	5	5	16	10	6.0	.0	.0
Augusta	426	62	77	29.79	29.98	−.03	80.8	+.4	98	1	89	66	23	72	24	72	70	80	8.50	+3.5	12	6.0	ne.	26	ne.	11	5	11	15	6.7	.0	.0
Savannah	51	73	152	29.89	29.96	−.05	81.8	+1.1	98	17	90	71	21	74	23	75	74	88	6.84	−.5	16	10.8	se.	73	n.	11	6	15	10	6.4	.0	.0
Jacksonville	43	86	110	29.93	29.98	−.03	82.0	+.3	95	17	90	68	21	74	20	75	73	86	6.89	+.8	16	7.6	sw.	24	sw.	5	3	17	11	6.5	.0	.0
Florida Peninsula							83.1	+0.9										82	8.23	+1.9										5.6		
Key West	21	10	64	29.96	29.98	.00	83.9	+.4	93	19	89	75	1	78	15	78	75	76	5.75	+1.2	16	7.0	e.	32	w.	3	8	13	10	5.5	.0	.0
Miami	25	124	168	29.97	29.99	−.03	82.8	+1.4	92	10	89	70	23	77	20	76	74	86	9.59	+3.4	17	7.0	se.	26	w.	1	3	14	14	6.7	.0	.0
Tampa	11	88	197	29.95	29.98	−.02	82.5	+1.0	93	7	90	71	23	75	20	76	74	83	9.34	+1.2	20	9.0	w.	34	e.	6	8	17	6	4.7	.0	.0
East Gulf States							80.8	+0.6										80	4.16	−1.2										5.5		
Atlanta	976	5	72	28.78	29.98	−.03	78.5	----	96	27	88	62	20	69	28	70	68	77	8.16	----	7	8.9	e.	29	ne.	11	6	14	11	6.1	.0	.0
Macon	464	79	87	29.58	29.97	−.04	80.0	+.1	98	17	89	67	24	71	24	72	70	80	6.85	+2.5	12	6.2	e.	25	w.	30	7	18	6	5.6	.0	.0
Thomasville	273	49	58	29.71	30.00	.00	80.8	−.2	95	17	90	66	20	72	26	----	----	----	2.91	−2.8	8	----	----	----	----	----	----	----	----	----	----	----
Apalachicola	35	11	51	29.93	29.96	----	82.2	+1.0	93	31	88	72	21	76	18	76	74	81	4.17	−3.4	13	7.7	w.	32	s.	5	2	19	10	6.4	.0	.0
Pensacola	56	54	79	29.91	29.97	−.01	81.8	+.9	94	14	89	66	21	74	24	75	73	80	6.55	−1.5	10	7.0	w.	31	se.	5	8	18	5	5.0	.0	.0
Anniston	741	9	----	29.41	30.02	+.03	78.5	+2.1	94	1	88	60	20	70	25	----	----	----	3.19	−.9	5	----	se.	----	----	----	7	22	2	----	----	----
Birmingham	630	11	48	29.26	29.99	.00	80.6	+1.4	97	16	90	59	20	71	26	71	68	76	2.14	−2.1	9	5.7	e.	24	s.	5	10	16	5	5.1	.0	.0
Mobile	29	86	161	29.91	29.97	−.01	81.6	+.6	95	13	90	62	21	73	26	74	72	84	2.24	−4.7	9	8.5	s.	29	ne.	6	10	16	5	5.0	.0	.0
Montgomery	237	92	105	29.72	29.97	−.02	82.0	+1.2	97	15	91	65	20	73	23	73	71	79	1.98	−2.2	7	6.4	e.	26	s.	28	9	14	8	5.4	.0	.0
Meridian	310	67	92	29.58	29.97	−.01	80.0	+.5	96	15	90	58	21	70	28	73	71	80	1.36	−3.2	10	5.0	e.	22	se.	6	8	14	9	5.5	.0	.0
Vicksburg	247	82	102	29.71	29.96	−.02	79.6	−1.2	93	15	87	59	21	72	24	73	70	79	3.80	+.3	10	7.3	sw.	18	s.	9	13	11	7	5.1	.0	.0
New Orleans	30	76	84	29.90	29.96	−.02	82.1	−.1	95	17	89	70	28	75	23	75	73	79	10.58	+4.8	15	6.7	w.	32	e.	6	7	15	9	5.9	.0	.0
West Gulf States							81.5	−0.4										74	3.09	0.0										4.6		
Shreveport	181	92	227	29.69	29.95	−.02	79.8	−4.2	95	13	89	59	21	71	29	72	70	81	8.62	+5.9	12	9.2	ne.	52	w.	27	21	5	5	3.2	.0	.0
Bentonville	1,303	12	51	28.63	29.96	−.01	75.2	−1.3	97	1	85	51	20	65	28	----	----	----	5.35	+1.3	13	5.2	s.	19	s.	9	8	15	8	5.4	.0	.0
Fort Smith	463	57	82	29.51	29.98	+.01	78.9	−1.6	98	3	88	58	21	69	25	69	65	69	5.26	+2.0	9	6.3	e.	26	s.	9	8	15	8	5.4	.0	.0
Little Rock	265	94	102	29.60	29.98	.00	78.6	−1.2	94	1	87	58	21	70	25	72	70	81	3.55	−.2	8	6.8	s.	27	nw.	27	10	9	12	5.6	.0	.0
Austin	605	68	90	29.30	29.92	----	83.3	−.5	100	29	94	62	21	72	34	71	66	66	1.77	−.3	2	7.3	s.	33	ne.	29	15	14	2	3.7	.0	.0
Brownsville	20	88	96	29.84	29.90	----	85.3	+1.4	101	7	93	70	22	77	24	76	73	77	.27	−2.3	3	11.0	se.	24	s.	28	11	15	5	4.5	.0	.0
Corpus Christi	44	11	78	29.80	29.92	−.01	85.2	+2.7	101	7	92	72	23	78	22	76	74	82	.66	−1.6	2	11.4	s.	25	s.	1	13	13	5	4.3	.0	.0
Dallas	488	220	227	29.40	29.93	----	80.5	----	99	3	90	60	20	71	26	71	66	66	1.31	−1.5	9	10.3	s.	40	n.	8	7	18	6	4.8	.0	.0
Fort Worth	706	35	56	29.24	29.94	.00	81.7	−1.3	103	3	93	58	20	70	29	70	65	65	2.16	−.5	5	9.6	se.	35	nw.	15	16	7	8	4.3	.0	.0
Galveston	9	106	114	29.87	29.93	−.03	82.0	−1.0	91	31	86	70	21	78	15	75	73	78	1.95	−2.3	7	10.5	s.	34	nw.	7	15	11	5	4.4	.0	.0
Houston	62	157	190	29.78	29.92	----	83.4	+.2	98	3	93	63	21	74	26	73	71	77	.82	−3.3	7	9.6	s.	30	nw.	7	12	14	5	4.5	.0	.0
Palestine	510	64	72	29.43	29.95	−.02	79.6	−2.2	95	14	89	61	21	70	28	71	68	73	2.54	+.4	10	7.0	s.	26	ne.	7	13	11	7	4.5	.0	.0
Port Arthur	34	59	134	29.90	29.93	----	81.1	----	93	30	88	63	21	74	21	74	72	79	7.76	+1.7	12	11.9	s.	82	ne.	7	12	13	6	4.8	.0	.0
San Antonio	582	111	301	29.20	29.91	−.02	85.1	+1.6	102	3	96	64	21	74	32	73	68	65	1.22	−1.2	5	10.5	se.	47	ne.	29	10	19	2	4.6	.0	.0
Ohio Valley and Tennessee							76.2	+1.3										73	3.13	−0.4										5.5		
Chattanooga	688	71	214	29.20	29.99	−0.01	77.8	+0.3	95	27	88	56	20	67	29	71	69	82	3.89	−0.1	8	5.1	n.	29	w.	18	7	14	10	5.9	0.0	0.0
Knoxville	980	66	84	28.97	30.01	.00	77.4	+1.2	95	17	87	62	20	68	26	69	66	79	5.25	+1.3	10	5.4	ne.	25	nw.	18	11	12	8	5.0	.0	.0
Memphis	284	78	86	----	30.07	−.01	80.0	+.6	98	1	88	59	20	72	22	71	----	79	2.40	−1.0	9	6.0	e.	25	sw.	8	9	17	5	----	.0	.0
Nashville	605	167	187	29.42	29.99	−.01	79.1	+1.3	97	17	88	58	22	70	29	70	67	76	1.33	−2.4	8	7.0	n.	31	w.	18	9	13	9	5.4	.0	.0
Lexington	989	6	----	----	----	----	76.7	+2.2	93	11	89	50	22	64	38	----	----	----	3.32	−.1	8	----	----	----	----	----	20	7	4	2.8	.0	.0

See footnotes at end of table.

CLIMATOLOGICAL DATA FOR WEATHER BUREAU STATIONS—Continued

District and station	Elevation of instruments: Barometer above sea level	Elevation of instruments: Thermometer above ground	Elevation of instruments: Anemometer above ground	Pressure: Station, reduced to mean of 24 hours	Pressure: Sea level, reduced to mean of 24 hours	Pressure: Departure from normal	Temperature of the air: Mean max.+mean min÷2	Temperature of the air: Departure from normal	Temperature of the air: Maximum	Temperature of the air: Date	Temperature of the air: Mean maximum	Temperature of the air: Minimum	Temperature of the air: Date	Temperature of the air: Mean minimum	Temperature of the air: Greatest daily range	Mean wet thermometer	Mean temperature of the dew-point	Mean relative humidity	Precipitation: Total	Precipitation: Departure from normal	Precipitation: Days with 0.01, or more	Wind: Average hourly velocity	Wind: Prevailing direction	Wind: Maximum velocity: Miles per hour	Wind: Maximum velocity: Direction	Wind: Maximum velocity: Date	Clear days	Partly cloudy days	Cloudy days	Average cloudiness, tenths	Total snowfall	Snow, sleet, and ice on ground at end of month
Ohio Valley and Tennessee—Continued	Ft.	Ft.	Ft.	In.	In.	In.	°F.	°F.	°F.		°F.	°F.		°F.	°F.	°F.	°F.	%	In.	In.		Miles							0-10	In.	In.
Louisville [3]	545	106	120	29.45	30.01	+.01	78.6	+1.6	95	17	88	55	22	69	29	68	64	71	1.59	−1.8	7	7.0	ne.	30	n.	19	14	11	6	4.4	.0	.0
Evansville	431	76	116	29.54	30.09	+.01	79.5	+2.1	97	17	89	57	22	70	28	68	64	65	1.66	−1.7	9	6.6	s.	26	n.	18	5	17	9	5.6	.0	.0
Indianapolis [3]	808	98	129	29.14	30.01	+.01	77.0	+3.3	98	17	87	53	24	67	26	65	60	67	2.91	−.4	8	6.9	e.	19	n.	18	5	14	12	6.0	.0	.0
Terre Haute	575	68	149	29.39	30.09		77.4		99	17	88	51	21	67	30	66	60	62	2.72	−.5	7	7.5	e.	23	nw.	18	6	15	10	5.5	.0	.0
Cincinnati [3]	497	11	51	29.36	30.02	+.01	76.2	+2.6	95	17	87	49	21	65	36	67	63	71	2.40	−1.0	8	5.9	ne.	21	nw.	27	13	7	11	5.5	.0	.0
Columbus [3]	833	90	110	29.18	30.03	+.02	75.1	+2.1	95	17	85	49	21	65	28	65	61	70	2.27	−1.0	9	8.1	e.	33	sw.	18	5	11	15	6.3	.0	.0
Dayton	900	188	213	29.10	30.04		74.8	+1.4	94	17	84	47	21	65	29	65	61	71	2.55	−.7	10	8.2	ne.	33	sw.	28	10	8	13	5.8	.0	.0
Elkins [3]	2,006	61	78	28.07	30.08	+.06	69.6	+.5	88	18	80	46	21	60	29	63	60	82	4.63	+.8	13	5.1	se.	19	w.	6	2	14	15	6.8	.0	.0
Parkersburg	637	77	84	29.37	30.04	+.03	74.4	+.5	93	18	84	51	21	64	30	66	63	75	5.59	+2.1	10	5.2	se.	25	s.	28	9	14	8	5.4	.0	.0
Pittsburgh [1]	1,273	39	54	29.18	30.08	+.07	70.8	−2.1	92	5	80	51	22	62	26	63	60	74	4.44	+1.2	12	9.0	s.	27	nw.	18	5	16	10	6.0	.0	.0
Lower Lake Region							70.1	+0.5										75	3.13	+0.1									5.6		
Buffalo [3]	706	243	279	29.27	30.09	+.10	69.6	+1.0	91	10	77	48	24	62	28	62	58	74	3.12	.0	11	10.6	s.	45	sw.	22	9	10	12	5.5	.0	.0
Canton	448	10	61	29.62	30.09		66.8	+.2	90	18	78	40	24	55	35	61	57	74	2.56	−1.1	8	5.6	sw.	18	w.	6	6	16	9	5.6	.0	.0
Ithaca	836	77	100	29.21	30.11		67.2	−1.4	89	10	78	35	25	56	34				2.73	−.6	9	7.5	se.	21	se.	29	8	12	11	6.0	.0	.0
Oswego	335	71	85	29.74	30.10	+.11	68.0	−.4	86	11	76	45	25	60	27	62	58	72	.74	−1.9	7	8.0	se.	24	se.	29	10	17	4	4.5	.0	.0
Rochester [3]	555	86	102	29.54	30.10	+.11	70.0	+.8	90	5	78	46	25	62	27	61	58	74	1.28	−1.6	10	6.7	s.	22	w.	22	10	13	8	5.3	.0	.0
Syracuse [3]	408	65	79	29.47	30.10	+.11	69.4	+.6	90	10	78	43	25	60	29	62	58	74	1.23	−1.6	5	7.1	s.	25	nw.	24	7	12	12	6.1	.0	.0
Erie	714	57	81	29.32	30.08	+.07	70.8	+1.2	92	18	78	49	24	64	23	63	60	75	3.16	−.1	9	7.8	se.	21	se.	16	8	15	8	5.7	.0	.0
Cleveland [3]	805	267	318	29.25	30.06	+.05	71.6	+1.6	90	18	78	53	24	65	23	64	61	75	3.82	+1.0	12	12.8	se.	35	n.	19	6	16	9	5.9	.0	.0
Sandusky	629	5	67	29.38	30.06	+.05	72.8	+1.0	93	4	81	53	22	65	24				5.63	+2.5	13	7.5	ne.	23	nw.	18	8	11	12	6.1	.0	.0
Toledo [3]	628	79	87	29.38	30.05	+.05	71.3	.0	92	4	79	49	24	63	23	64	62	78	3.60	+.7	12	8.2	e.	27	s.	4	18	9	4	4.2	.0	.0
Fort Wayne [3]	828	69	84	29.13	30.04		73.1	+1.4	94	17	83	50	24	63	25	64	60	74	2.17	−.9	10	7.4	e.	27	w.	4	5	14	12	6.1	.0	.0
Detroit [1]	626	5	78	29.30	30.07	+.06	70.4	+.1	91	12	79	45	24	62	26	64	61	76	7.51	+4.7	12	8.0	e.	31	s.	4	5	12	14	6.5	.0	.0
Upper Lake Region							67.3	+0.9										80	4.76	+1.8									6.9		
Alpena	609	13	89	29.42	30.09	+.09	66.5	+2.4	84	13	73	42	24	60	23	62	59	81	3.74	+.9	14	9.4	se.	24	n.	18	5	11	15	6.9	.0	.0
Escanaba	612	51	72	29.41	30.07	+.08	65.3	+1.0	82	17	72	42	23	59	27	61	59	81	3.01	−.2	14	9.5	s.	29	n.	18	4	11	16	7.0	.0	.0
Grand Rapids [3]	689	70	244	29.28	30.03	+.03	70.6	+.9	93	16	79	48	23	62	24	63	60	79	7.40	+4.8	17	8.6	e.	25	n.	18	7	11	13	6.4	.0	.0
Lansing	878	5	90	29.13	30.06		68.5	.0	90	12	78	46	24	60	30			80	9.21	+6.4	14	7.0	se.	22	sw.	28	8	15	8	5.8	.0	.0
Marquette	734	44	73	29.26	30.05	+.07	65.2	+1.4	87	9	72	44	23	58	27	60	56	77	1.69	−1.0	13	7.0	s.	29	sw.	21	5	9	17	7.2	.0	.0
Sault Sainte Marie [3]	724	11	52	29.41	30.08	+.09	64.9	+2.8	88	11	74	39	24	56	30	58	56	81	3.67	+1.0	11	6.2	se.	18	se.	28	7	6	18	6.9	.0	.0
Chicago	673	7	131	29.31	30.02	+.02	72.0	+.4	92	5	78	54	21	66	22	65	62	77	3.95	+.7	17	8.4	ne.	27	nw.	5	4	11	16	7.0	.0	.0
Green Bay	617	109	141	29.38	30.04	+.05	67.8	+.1	89	16	75	42	23	60	25	62	59	78	6.12	+2.9	17	8.7	s.	31	sw.	30	4	5	22	7.6	.0	.0
Milwaukee [3]	698	126	221	29.31	30.03	+.03	68.4	−.8	85	16	74	49	23	63	20	63	61	83	6.68	+4.0	14	10.1	e.	28	sw.	30	3	12	16	7.1	.0	.0
Duluth	1,133	5	47	28.82	30.03	+.06	63.8	+1.2	86	8	72	39	23	56	28	58	56	81	2.14	−1.0	17	10.6	ne.	30	nw.	21	5	9	17	7.1	.0	.0
North Dakota							67.9	+2.0										66	1.96	−0.3									3.9		
Moorhead, Minn. [3]	899	50	58	29.01	30.01	+.05	66.8	+.7	90	12	76	43	22	57	34	61	57	75	3.32	+.4	10	7.0	se.	27	ne.	2	14	7	10	4.9	.0	.0
Bismarck [1]	1,660	4	41	28.24	29.99	+.05	69.9	+2.6	97	10	84	39	31	55	45	59	52	62	.32	−1.5	4	10.9	s.	34	e.	23	18	9	4	3.6	.0	.0
Devils Lake	1,478	11	44	28.46	30.02	+.08	66.0	+1.2	90	11	77	45	31	55	33	58	55	74	3.38	+.9	9	7.7	se.	38	n.	15	15	5	11	4.7	.0	.0
Lemmon, S. Dak.	2,602	4	38																												
Grand Forks	832	12	67	29.12	30.01		66.2	+.8	90	12	78	44	19	55	34	61	58		2.05	−.6	9						11	8	12		.0	.0
Williston	1,878	42	50	28.01	29.95	+.02	70.6	+4.5	99	9	85	43	18	56	40	57	48	53	.73	−.7	5	7.0	se.	26	w.	1	22	9	0	2.3	.0	.0
Upper Mississippi Valley							72.8	0.0										78	5.11	+1.8									6.5		
Minneapolis-St. Paul, Minn. [1]	838	32	61	29.03	30.01	+.04	68.8	−1.1	91	12	77	49	23	61	26	62	59	78	4.54	+1.4	17	8.9	se.	37	n.	15	4	8	19	7.2	.0	.0
Springfield, Minn.	1,025	4	42																												
La Crosse [3]	672	11	48	29.25	30.02	+.04	69.1	−.9	89	12	77	48	23	61	27	63	60	80	6.87	+3.2	19	4.1	s.	17	se.	14	4	9	18	7.5	.0	.0
Madison [3]	866	70	78	29.11	30.03	+.04	69.3	−.5	89	2	76	48	23	62	23	63	61	81	6.15	+2.9	22	6.6	se.	20	n.	17	2	14	15	7.0	.0	.0
Charles City	1,015	10	51	28.95	30.03	+.06	68.5	−.6	91	2	77	47	20	60	26	63	61	81	8.76	+5.3	16	5.0	se.	21	w.	4	7	8	16	6.9	.0	.0
Davenport [3]	606	66	161	29.36	30.02	+.04	73.4	+.3	99	2	82	52	20	65	27	66	63	78	4.80	+1.3	15	7.6	sw.	21	sw.	17	7	8	16	6.4	.0	.0
Des Moines [3]	963	5	99	29.08	29.99	+.02	72.2	−.9	96	2	80	50	20	64	26	65	62	78	6.72	+3.2	16	7.8	se.	33	se.	12	11	7	13	5.9	.0	.0
Dubuque	699	60	79	29.28	30.01	+.03	71.0	−.7	96	2	79	51	21	63	26	65	62	78	6.72	+3.5	16	5.0	nw.	18	nw.	1	4	10	17	7.2	.0	.0
Keokuk	614	64	78	29.35	30.00	+.02	74.6	−.4	101	2	83	54	20	66	30	67	64	76	6.11	+2.9	17	5.7	e.	22	sw.	17	9	7	15	6.1	.0	.0
Cairo	358	87	93	29.61	29.98	−.01	78.4	+.6	93	17	87	59	20	70	26	70	67	75	.77	−2.2	7	5.7	s.	20	nw.	27	5	15	11	6.3	.0	.0
Peoria [3]	662	11	45	29.36	30.01	+.02	74.8	+2.3	99	3	85	50	21	65	32	66	63	78	3.29	+.2	15	4.2	n.	16	s.	3	10	10	11	5.4	.0	.0
Springfield, Ill. [3]	616	5	191	29.33	30.00	+.01	76.7	+2.2	98	3	86	53	24	67	29	66	62	74	2.47	−.7	12	8.9	s.	24	n.	5	7	9	15	6.5	.0	.0
St. Louis [6]	564	179	303	29.40	30.00	+.01	77.0	−.5	99	2	87	50	21	67	31	68	65	75	4.11	+1.1	11	8.7	sw.	35	s.	3	7	18	6	5.2	.0	.0
Missouri Valley							74.0	+0.2										74	4.75	+1.4									5.7		
Columbia, Mo. [3]	785	6	66	29.17	29.99	+.02	76.6	+1.0	101	2	86	52	20	67	26	68	65	79	6.64	+3.4	12	6.0	s.	19	ne.	14	6	17	8	6.2	.0	.0
Kansas City [1]	750	38	76	28.87	29.97	.00	76.3	−.3	101	1	85	52	20	67	30	68	64	71	6.48	+2.4	12	8.3	ne.	40	nw.	26	9	11	11	5.7	.0	.0
St. Joseph [3]	817	11	49	28.97	29.98	.00	75.0	−1.5	99	1	84	51	20	66	27	67	65	81	7.13	+3.3	13	7.0	e.	30	nw.	5	10	12	9	4.9	.0	.0
Springfield, Mo. [3]	1,360	5	78	28.62	30.00	+.03	74.6	−1.1	97	1	84	49	20	65	28	68	66	84	5.36	+1.3	13	8.2	s.	31	ne.	29	5	11	15	6.5	.0	.0
Topeka	987	65	87	28.94	29.97		76.4	+.2	104	1	87	53	20	66	30	67	63	71	6.40	+2.3	15	7.6	s.	28	sw.	26	6	9	16	6.5	.0	.0
Lincoln [3]	1,189	11	81	28.73	29.96	+.01	73.7	−.7	98	2	84	51	19	64	33	65	61	72	3.59	.0	13	7.7	e.	32	sw.	2	5	14	12	6.3	.0	.0
Omaha [1]	982	31	44	28.83	29.99	+.03	72.8	−1.6	98	1	82	52	19	63	27	66	63	76	5.00	+2.0	13	8.3	se.	41	n.	4	8	10	13	6.1	.0	.0
Valentine	2,598	46	54	27.31	29.98	+.04	72.1	+.4	99	2	85	45	31	59	41	60	54	63	.94	−1.2	7	7.9	s.	31	nw.	2	15	12	4	3.9	.0	.0
Sioux City [3]	1,138	64	106	28.80	29.99	+.04	71.4	−.6	94	2	81	50	19	62	28	65	62	79	4.18	+1.0	12	7.9	s.	48	nw.	4	5	17	9	5.8	.0	.0
Huron	1,289	26	41	28.62	29.98	+.03	71.5	+2.1	101	2	83	46	31	60	36	61	56	66	1.80	−.7	6	12.0	se.	34	se.	23	12	12	7	4.7	.0	.0
Northern Slope							69.8	+3.8										46	0.47	−0.7									3.5		
Billings [1]	3,570	18	39	26.35	29.92		73.2		104	12	89	47	29	58	44	55	40	36	.13		2	9.4	sw.	34	nw.	23	15	12	4	3.5	.0	.0
Havre	2,507	11	67	27.36	29.95	+.04	70.3	+4.9	105	12	87	45	17	54	49	53	40	41	.31	−.9	3	7.5	e.	27	e.	22	24	7	0	1.7	.0	.0
Helena	4,124	85	111	25.85	29.94	.00	69.9	+4.9	103	12	87	42	5	52	48	52	37	35	T	−.8	0	8.3	w.	35	sw.	21	17	10	4	3.4	.0	.0
Missoula [3]	3,189	80	91	26.65	29.96		71.0	+5.4	100	12	89	44	29	53	47	53	39	40	.14	−.8	2	6.2	nw.	25	nw.	27	20	9	2	2.6	.0	.0
Kalispell	2,973	48	56	26.95	29.94	+.01	66.7	+3.9	94	12	83	43	29	51	41	52	41	61	.02	−.8	2	6.3	w.	19	w.	9	21	9	1	3.2	.0	.0
Miles City [3]	2,634	48	55	27.49	29.93	.00	74.6	+3.1	103	13	89	48	18	61	40	57	44	42	.93	−.2	4	6.1	se.	29	nw.	1	14	14	3	3.6	.0	.0
Rapid City [3]	3,218	50	58	26.67	29.96	+.03	71.8	+2.3	97	14	84	50	6	59	38	57	46	49	1.18	−.5	4	7.1	se.	26	n.	17	17	11	3	3.0	.0	.0
Cheyenne [1]	6,144	5	39	24.13	29.97	+.05	67.2	+1.6	93	2	82	45	30	52	40	53	45	55	.82	−.7	7	9.5	nw.	38	ne.	22	9	11	11	5.5	.0	.0
Lander	5,352	60	68	24.74	29.92	.00	69.8	+4.3	95	13	86	47	29	54	42	53	42	45	.52	.0	1	5.0	sw.	27	sw.	7	14	13	4	3.9	.0	.0
Sheridan [1]	3,790	10	47	26.15	29.94		71.3		101	11	89	41	30	54	49	54	41	40	.07	−.8	3	4.5	s.	21	nw.	2	14	11	6	4.5	.0	.0
Yellowstone Park	6,241	12	46	24.01	30.04	+.11	63.6	+4.5	92	12	80	38	29	47	43	49	39	47	.44	−.8	4	7.4	sw.	26	nw.	22	18	11	2	3.1	.0	.0
North Platte [3]	2,787	11	51	27.09	29.95	+.01	73.4	+2.6	96	4	86	46	31	60	42	61	55	64	.71	−1.7	8	6.8	se.	30	n.	4	15	12	4	3.9	.0	.0

See footnotes at end of table.

CLIMATOLOGICAL DATA FOR WEATHER BUREAU STATIONS—Continued

District and station	Elevation of instruments: Barometer above sea level	Elevation of instruments: Thermometer above ground	Elevation of instruments: Anemometer above ground	Pressure: Station, reduced to mean of 24 hours	Pressure: Sea level, reduced to mean of 24 hours	Pressure: Departure from normal	Temperature of the air: Mean max.+mean min.÷2	Temperature of the air: Departure from normal	Temperature of the air: Maximum	Temperature of the air: Date	Temperature of the air: Mean maximum	Temperature of the air: Minimum	Temperature of the air: Date	Temperature of the air: Mean minimum	Temperature of the air: Greatest daily range	Mean wet thermometer	Mean temperature of the dew-point	Mean relative humidity	Precipitation: Total	Precipitation: Departure from normal	Precipitation: Days with 0.01, or more	Wind: Average hourly velocity	Wind: Prevailing direction	Wind: Maximum velocity: Miles per hour	Wind: Maximum velocity: Direction	Wind: Maximum velocity: Date	Clear days	Partly cloudy days	Cloudy days	Average cloudiness, tenths	Total snowfall	Snow, sleet, and ice on ground at end of month
	Ft.	Ft.	Ft.	In.	In.	In.	°F.	°F.	°F.		°F.	°F.		°F.	°F.	°F.	°F.	%	In.	In.		Miles								0–10	In.	In.
Middle Slope							75.4	−0.6										62	2.67	+0.2										4.9		
Denver [2]	5,332	106	113	24.83	29.96	+0.04	71.8	+1.1	94	2	84	55	30	60	34	55	46	51	0.38	−1.0	8	7.2	s.	34	n.	7	10	17	4	4.5	0.0	0.0
Pueblo [2]	4,806	79	86	25.36	29.93	+.02	72.6	−.1	97	4	88	53	28	57	42	57	49	54	.82	−1.0	9	7.7	e.	34	n.	10	8	20	3	5.0	.0	.0
Concordia	1,392	50	58	28.53	29.97	+.02	75.2	−1.3	102	1	85	53	19	65	30	66	62	70	3.74	+.8	12	6.8	se.	23	n.	4	7	14	10	5.7	.0	.0
Dodge City	2,509	10	86	27.40	29.94	+.01	75.8	−1.9	101	1	87	56	30	64	33	64	59	64	5.09	+2.4	12	9.8	s.	30	s.	25	8	19	4	5.0	.0	.0
Wichita [2]	1,372	85	93	28.55	29.95	.00	77.4	−.9	99	3	88	55	19	67	32	67	62	66	2.87	−.3	10	8.9	se.	29	nw.	3	8	19	4	4.6	.0	.0
Oklahoma City [2]	1,304	10	47	28.69	29.95	+.01	79.3	−.4	101	3	90	57	20	69	28	68	64	67	3.14	+.2	8	7.5	s.	26	ne.	5	9	16	6	4.8	.0	.0
Chadron, Nebr.																															
Southern Slope							79.6	0.0										60	2.34	0.0										6.0		
Abilene [2]	1,750	10	56	28.15	29.91	−.01	82.0	.0	104	3	94	57	20	70	31	67	62	60	2.26	−.0	8	8.3	s.	24	se.	15	13	12	6	4.5	.0	.0
Amarillo [2]	3,604	10	49	26.31	29.93	+.01	76.8	+1.1	98	3	89	61	19	65	31	62	56	62	.71	−2.4	10	8.7	se.	27	ne.	16	14	16	1	4.0	.0	.0
Del Rio	960	63	71	28.91	29.86	−.04	82.8	−1.4	101	4	93	62	20	73	30	71	65	61	5.62	+3.9	8	8.3	se.	30	s.	29	9	15	7	5.0	.0	.0
Roswell	3,566	75	85	26.39	29.92	+.04	76.8	+.2	98	3	89	59	28	65	35	62	55	55	.79	−1.4	8	7.1	s.	33	nw.	10	14	11	6	4.5	.0	.0
Southern Plateau							78.4	−1.5										50	1.22	−0.1										3.4		
El Paso [2]	3,916	82	101	26.19	29.87	+.03	79.6	+.4	100	10	91	62	13	68	32	63	54	49	.78	−.9	9	7.9	e.	29	n.	10	16	13	2	3.5	.0	.0
Albuquerque [1]	5,314	5	34	25.12	29.89	.....	74.2	+.3	95	17	87	55	26	61	32	59	51	54	3.25	+2.0	12	7.8	se.	40	se.	10	11	14	6	5.1	.0	.0
Santa Fe	7,013	38	53	23.80	29.97	+.08	67.2	−.2	87	4	79	46	26	55	32	54	47	57	1.66	−.6	13	5.7	e.	25	n.	4	7	12	12	5.9	.0	.0
Flagstaff	6,907	10	59	23.47	29.88	+.04	66.0	+3.2	90	11	81	40	26	51	41	53	45	57	2.26	−.5	13	7.4	nw.	27	nw.	18	18	10	3	3.8	.0	.0
Phoenix [2]	1,112	39	87	28.67	29.78	−.01	91.0	+2.5	113	8	104	70	26	78	34	70	58	38	.48	−.5	5	6.1	e.	27	se.	18	10	0	0	.5	.0	.0
Yuma	142	9	54	29.63	29.77	+.01	92.1	+1.7	115	8	107	65	26	78	38	72	62	44	.10	−.4	1	5.5	se.	23	se.	12	5	0	0	.6	.0	.0
Independence	3,957	5	26	25.95	29.89	+.08	78.6	+2.5	103	11	96	55	24	62	40	54	33	---	.00	−.1	0	4.0	s.	---	---	---	---	---	---	---	---	---
Middle Plateau							75.6	+4.2										34	0.21	−0.5										2.8		
Ely [1]	6,262	5	41	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Reno [2]	4,400	61	76	25.48	29.93	+.09	73.6	+4.9	100	11	91	49	28	56	41	53	40	45	.00	−.2	0	6.1	w.	21	w.	13	25	4	2	1.8	.0	.0
Tonopah	6,090	12	20	24.21	29.89	.....	76.0	.....	96	11	88	54	25	64	29	52	31	.....	.00	.....	0	.....	.....	.....	.....	.....	.....	.....	.....	.....	.0	.0
Winnemucca	4,344	18	56	25.61	29.90	+.02	74.5	+5.2	106	11	96	45	28	54	53	51	30	25	.28	+.1	1	6.2	sw.	17	ne.	4	22	8	1	2.5	.0	0
Modena	5,473	10	46	24.67	29.87	+.01	72.4	+3.2	101	12	90	42	26	54	48	52	37	35	.49	−.8	4	10.1	sw.	32	s.	13	21	9	1	3.0	.0	.0
Salt Lake City [2]	4,227	86	210	25.61	29.86	−.05	80.0	+5.5	102	9	94	56	29	66	37	56	41	32	.02	−.8	1	7.3	s.	31	e.	21	21	8	2	2.8	.0	.0
Grand Junction	4,602	60	68	25.41	29.91	+.01	77.6	+2.2	100	14	92	52	27	64	37	57	42	35	.28	−.9	5	6.2	se.	30	nw.	25	16	10	5	3.9	.0	.0
Northern Plateau							72.0	+3.3										38	0.05	−0.4										2.6		
Baker [2]	3,373	36	54	26.46	29.98	+.03	68.4	+3.8	100	19	87	42	14	50	47	50	39	50	T	−.5	0	6.2	n.	18	sw.	20	23	6	2	2.4	.0	.0
Boise [1]	2,858	5	49	27.12	29.88	−.05	74.2	.....	100	8	91	48	15	58	41	54	38	30	.01	.....	1	9.2	nw.	21	nw.	4	18	8	5	3.3	.0	.0
Pocatello [1]	4,478	5	31	25.50	29.90	−.04	72.8	.....	101	12	91	44	30	55	52	53	37	32	.12	.....	1	8.7	w.	26	s.	23	13	14	4	3.9	.0	.0
Spokane [2]	1,968	101	110	27.95	29.94	−.01	70.6	+2.5	96	19	86	48	29	56	42	54	42	42	.01	−.6	1	5.6	s.	21	sw.	12	24	6	1	1.7	.0	.0
Walla Walla	991	57	65	28.90	29.95	−.01	75.4	+2.7	101	19	89	54	29	62	39	57	41	33	T	−.5	0	5.5	s.	18	sw.	12	22	8	1	2.2	.0	.0
Yakima	1,076	58	67	28.83	29.96	.....	73.8	+4.3	98	6	88	52	28	59	38	57	44	38	T	−.2	0	6.7	nw.	18	nw.	12	23	6	2	1.9	.0	.0
North Pacific Coast Region							66.2	+2.7										68	0.65	−0.2										4.1		
North Head	211	5	56	29.87	30.09	+.06	59.5	+1.9	76	5	64	52	18	55	22	57	56	92	1.87	+.8	10	14.0	n.	33	n.	2	6	11	14	6.0	.0	.0
Seattle [2]	14	90	321	29.92	30.05	+.05	66.4	+3.3	89	18	75	54	23	58	29	58	53	69	.24	−.5	4	8.1	n.	27	s.	27	13	9	9	4.6	.0	.0
Tacoma	194	172	201	29.87	30.07	+.05	65.0	+2.4	87	8	74	52	15	56	30	.....	.....	.....	.47	−.3	3	7.5	n.	22	sw.	27	13	7	11	5.0	.0	.0
Tatoosh Island	86	9	61	29.99	30.08	+.08	57.6	+2.3	75	18	62	50	11	53	24	55	54	90	1.87	−.2	12	10.7	s.	33	e.	17	10	10	11	5.7	.0	.0
Medford [1]	1,329	29	58	28.57	29.94	.....	73.6	+2.5	101	11	92	50	14	55	46	58	45	44	T	−.2	0	.....	nw.	.....	.....	.....	28	2	1	1.2	.0	.0
Portland, Oreg. [2]	39	68	106	29.86	30.03	+.02	70.4	+3.7	99	17	82	52	13	59	35	60	53	61	.07	−.6	3	7.0	nw.	17	nw.	16	14	14	3	4.0	.0	.0
Roseburg	510	45	76	29.46	30.00	.00	71.1	+3.1	99	5	87	50	21	56	43	59	50	54	.00	−.3	0	5.4	n.	18	n.	15	26	5	0	1.6	.0	.0
Middle Pacific Coast Region							68.6	+1.5										63	T	0.0										3.4		
Eureka	60	72	88	29.97	30.04	+.04	58.0	+2.0	69	27	62	50	14	54	15	55	53	87	.00	−.2	0	6.0	nw.	20	nw.	12	6	12	13	6.0	.0	.0
Redding [1]	722	20	34	29.11	29.86	.....	82.3	+1.8	107	10	96	61	23	68	37	60	41	27	.00	.0	0	7.0	se.	17	se.	15	25	6	0	1.3	.0	.0
Sacramento [2]	25	92	115	29.81	29.88	+.03	74.2	+1.3	104	10	91	52	15	58	43	60	52	54	.00	.0	0	7.5	s.	18	sw.	15	29	1	1	.8	.0	.0
San Francisco	155	112	132	29.78	29.95	+.03	60.0	+.9	81	10	65	53	30	55	26	56	54	84	T	.0	0	10.0	w.	24	w.	1	7	16	8	5.7	.0	.0
South Pacific Coast Region							73.3	−0.2										63	T	0.0										2.4		
Fresno [1]	327	89	98	29.52	29.86	+.04	80.2	−.5	110	11	98	55	24	62	40	62	49	41	.00	.0	0	6.5	nw.	15	nw.	22	28	1	2	1.0	.0	.0
Los Angeles	512	223	250	29.57	29.92	+.04	70.6	−.5	89	19	81	57	26	60	26	62	58	71	.00	.0	0	5.7	w.	18	w.	18	21	10	0	2.2	.0	.0
San Diego [2]	28	62	70	29.89	29.92	+.03	69.1	+.4	80	19	75	59	26	63	17	63	60	76	T	.0	0	7.0	w.	17	w.	17	15	15	1	4.0	.0	.0
West Indies																															
San Juan, P. R.	82	10	54	29.92	30.00	+.5	81.0	.....	90	24	86	74	18	76	14	.....	.....	.....	4.32	−1.7	22	10.8	e.	40	ne.	5	2	25	4	5.5	.0	.0
Panama Canal																															
Balboa Heights	118	6	92	.....	[3] 29.82	−.01	81.4	+.2	92	1	88	71	10	75	19	.....	.....	[3]84	4.59	−3.1	16	6.1	nw.	26	se.	9	0	12	19	7.7	.0	.0
Cristobal	36	6	97	.....	[3] 29.83	−.01	81.4	+1.2	90	22	86	74	21	77	13	77	76	[3]85	19.04	+3.8	27	7.9	w.	29	n.	9	0	4	27	9.3	.0	.0
Alaska																															
Fairbanks	454	11	87	[4] 29.20	[4] 29.70	.....	57.6	+2.4	80	3	71	39	1	44	37	51	45	68	2.13	+.1	8	5.3	e.	21	sw.	17	4	10	17	6.9	.0	.0
Juneau	80	96	116	[4] 29.81	[4] 29.90	.....	54.8	−.5	72	21	60	46	31	50	25	52	49	82	10.79	+3.6	24	7.6	se.	28	se.	29	1	5	25	8.7	.0	.0
Nome	22	5	59	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Hawaiian Islands																															
Honolulu	38	86	100	29.93	29.97	.....	79.8	+1.4	86	12	84	73	2	76	10	72	68	71	.99	−.3	18	10.7	e.	27	e.	26	4	24	3	5.3	.0	.0

[1] Data are airport records.
[2] Barometric and hygrometric data from airport, other data city office records.
[3] Observations taken bihourly.
[4] Pressure not reduced to a mean of 24 hours.
[5] Barometric, hygrometric, and temperature records from airport, other date from city office.
[6] Barometric data from airport records, other data city office records.

NOTE.—Except as indicated by notes, 1, 2, 5, and 6 data in table, are city office records.

SEVERE LOCAL STORMS

[Compiled by MARY O. SOUDER from reports submitted by Weather Bureau officials]

[The table herewith contains such data as have been received concerning severe local storms that occurred during the month. A revised list of tornadoes will appear in the United States Meteorological Yearbook]

Place	Date	Time	Width of path, yards	Loss of life	Value of property destroyed	Character of storm	Remarks
Miami, Fla., 8 or 10 miles west.	1	4:15 p. m.	----------	0	$1,500	Tornado	Building unroofed and south wall collapsed. Roof damage to several other buildings. Path from west-southwest to east-northeast. The funnel was never seen to reach the ground.
Montana, north-central counties.	1	----------	----------	------	342,000	Severe hail	Crop loss, $335,000; property damage, $7,000.
Lincoln, Nebr.	2	8–10 p. m.	[1] 5	------	2,000	Thundersquall	Property damaged.
Albuquerque, N. Mex.	2	9–10 p. m.	[1] 3	------	10,000	Electrical and heavy rain.	Streets washed, some basements flooded.
Waco, Nebr.	2	P. m.	[1] 2	------	1,000	Wind and hail	Property damaged.
Wichita, Kans.	3	3:07–4:45 p. m.	[1] 15	------	25,000	Thundersqualls	Property damaged; path 30 miles long.
Kremlin, Okla., 3 miles south.	3	5:10 p. m.	[1] 1½	------	2,500	Straight-line wind.	Property damaged; slight crop loss; path 3 miles long.
Greenburg, Kans.	3	6 p. m.	880	------	15,000	Heavy hail	Property damaged; path 1½ miles long.
Longdale, Okla., vicinity of.	3	do	----------	------	----------	Straight-line wind.	Farmhouse demolished; other property damaged.
Polk and Mahnomen Counties, Minn.	3	8:30–10:30 p. m.	[1] 1	------	15,000	Thundersqualls and hail.	Barn and garage wrecked; several barns and outbuildings moved from their foundations, partly unroofed or otherwise damaged. Trees uprooted; corn lodged. Crop loss from hail, $9,000, in Mahnomen County; in Polk County, $1,000; path 30 miles long.
Altona, Okla.	3	8:45 p. m.	----------	------	----------	Straight-line wind.	Garage and several farm buildings demolished; other buildings damaged.
New Boston, Ill.	3	----------	----------	------	21,000	Wind	Loss to crops, $2,000; property damage, $1,000.
Brown County, S. Dak.	4	2 p. m.	[1] 5	------	----------	Wind and hail	Loss in poultry and livestock; growing crops total loss in places.
Day County, S. Dak.	4	2:15 p. m.	[1] 6–8	------	150,000	Heavy hail and high wind.	Property damage, $50,000; crop loss, $100,000.
Do.	4	2:30 p. m.	[1] 7	------	9,000	do	Property damage; loss in crops.
Castlewood, S. Dak., and vicinity.	4	4:15 p. m.	[1] 1	------	12,000	High wind	Church blown over; 2 barns and small sheds wrecked; some trees uprooted; grain shocks down.
Hand County, S. Dak.	4	4:30 p. m.	[1] 4	------	11,000	Wind, rain and hail.	Farm buildings and machinery wrecked; flock of 120 young turkeys killed; crop loss heavy, but not estimated.
Wagner, S. Dak., vicinity of.	4	4:40–5:30 p. m.	100	------	15,000	High wind and dust.	Property damaged; minor crop loss.
Geddes, S. Dak., vicinity of.	4	4:45–6 p. m.	----------	------	1,000	High wind	Property damaged.
Loyal, Okla., ½ mile north.	5	6:30 p. m.	440–880	0	15,000	Small tornado and hail.	Storm moved from northwest to southeast. Damage to buildings; a church demolished; path 3½ miles long.
Inola, Okla., 4 miles west.	5	----------	200	0	2,200	Small tornado	Property damage on 1 farm; path 333 yards long.
Winchester, Va., 4 miles east.	5	----------	----------	------	----------	Tornadic wind	School building demolished.
Alabama.	6	----------	----------	------	1,000	Tropical storm	The storm moved inland into Louisiana, caused strong winds and high tide on the coast with small damage in Alabama.
Knoxville, Tenn.	6	----------	----------	------	5,000	Thunderstorm	Property damaged.
Louisiana, extreme southern portions.	6–7	----------	----------	------	200,000	Tropical hurricane.	Principal loss to crops, $200,000. Additional unknown losses to trapping interests, because of the drowning of a part of the muskrats, not estimated. Not included in this estimate are the greater damage from floods in southwestern Louisiana attending and following heavy rains of August. 6-9 and losses to crops and property damage including livestock.
Two Buttes, Colo.	7	3 p. m.	[1] 7	------	75,000	Heavy hail	There were 2 separate storms.
Cimarron County, Okla.	7	6–7 p. m.	----------	------	45,000	2 hailstorms	The first storm occurred over a strip 9 by 16 miles west of Boise City, the area affected being 7 miles wide and about 15 miles long, while the other storm was 3 to 6 miles east of Boise City with a path 3 miles wide and nearly 15 miles long. Loss to crops.
Solano, N. Mex., vicinity of.	9	4 p. m.	[1] 4	------	1,000	Heavy hail	Loss to crops.
Lincoln and Frontier Counties, Nebr.	9	4–9 p. m.	[1] 6	------	100,000	Hail, wind, and heavy rain.	Hail, heavy and long continued, denuded about 125 sections of land and was the principal cause or damage. Some damage to buildings and trees by wind and to fields from flooding.
Thomas County, Kans.	9	6:30–7 p. m.	[1] 5	------	10,000	Heavy hail	Chief loss in grain sorghums; some property damage; path 25 miles long.
Campobello and Pacolet, S. C.	10	Early afternoon.	----------	0	2,000	Tornadoes	Property damaged.
South Carolina, coastal area from Charleston southward.	11	2:30 p. m.	----------	34	----------	Hurricane	Property damage along the South Carolina southern coast was heavy, especially severe at Folly Beach, near Charleston, Edisto Island Beach and City and County of Beaufort, including U.S. Marine Corps base on Parris Island and Town of Port Royal where water front buildings, communication and power lines were wrecked, many trees uprooted and high tides flooded streets and ground floors of buildings. Over 200 houses in Beaufort County totally wrecked and over 1,000 damaged. This reported to be the worst storm since 1893.
Augusta, Ga.	11–12	----------	----------	------	$226,500	High wind and heavy hail.	Damage in Augusta and vicinity, $1,500. Loss to canal gates estimated at about $225,000.
Savannah, Ga.	11–12	----------	----------	2	850,000	High wind and heavy rain.	During this subtropical hurricane, wind reached a velocity of 73 miles per hour, with the lowest barometer reading on record. Property damaged.
Leon, Iowa, 17 miles northwest.	12	P. m.	----------	------	----------	Rain and flood	Grand River overflowed. Many fields flooded; some highways under water.
Belvidere to Cherry Valley, Ill.	12	----------	----------	------	60,000	Hail	Crop loss, $50,000; property damage, $10,000.
Des Moines, Mitchellville, and Colfax, Iowa.	13	10:20 a. m.	----------	------	----------	Wind and heavy rain.	Streets, stores, basements, and electric conduits flooded causing interruption of electric and trolley service. Traffic delayed as water rose to running boards of cars. Electric wires and poles blown down in Des Moines and between Des Moines and Polk City. Highways and fields flooded between Colfax and Mitchellville.
Tucson, Ariz., vicinity of.	13	P. m.	----------	1	125,000	Heavy rain and flood.	Excessive rain in eastern Prima, Santa Cruz, and southeastern Cochise Counties, caused much damage. A flash flood in the vicinity of Tucson flooded parts of the city and disrupted power service. Tangible property loss estimated at $75,000, with resulting loss in business of $50,000.

[1] Miles instead of yards.

SEVERE LOCAL STORMS—Continued

Place	Date	Time	Width of path, yards	Loss of life	Value of property destroyed	Character of storm	Remarks
Greensboro, N. C., 15 miles southeast.	14	5:20 a. m.	100	0		Tornado	On 1 farm 3 tobacco barns were destroyed, 1 full of tobacco for curing. Storm moved north-northeastward; path 2 miles long.
Rutland, Ill.	14				$2,200	Hail	Crop loss, $2,000; property damage, $200.
Manchester, Iowa, and vicinity.	14					Electrical	Barn struck by lightning. A threshing crew had taken refuge in the building and 13 men and 17 horses were stunned by the bolt, but without serious injury. 2 houses struck by lightning with considerable damages.
Drysville and Lattnerville, Iowa, and vicinities.	14–15	P. m.		1	8,500	Rain and flood	Several hundred acres of farmland and 3 city blocks flooded; about 40 homes affected. Highways covered with water and several hundred feet of railroad track washed out. Loss to crops, $3,500; property damage, $5,000.
Virginia	14–18				1,430,500	Floods	Floods of the James, Meherrin, Roanoke, and Blackwater Rivers caused $860,000 damage to highways and bridges, about $565,000 to crops and material which was not movable, and around $5,500 to livestock.
Raymond, S. Dak., vicinity of.	15	4–6 p. m.	[1] 1		10,000	High wind	10 farm buildings and garage wrecked; other buildings damaged; minor crop loss; path 8½ miles long.
Traverse County, Minn.	15	P. m.			10,000	Thundersqualls and hail.	Several silos and small buildings wrecked. Loss to growing crops, $9,000; property damage, $1,000.
Seneca to Thedford, Nebr.	16	1:30–3:30 p. m.	[1] 1–2		3,000	Hail and excessive rain.	Hail severe, but over grassland; principal damage by flooding.
Chouteau, Mont.	16	4 p. m.			600	Wind	Damage to shocked grain; granary and fence destroyed.
St. Vrain, N. Mex., vicinity of.	16	9 p. m.	[1] 1		7,000	Heavy hail	Loss to crops.
Vanderburg County, Ind.	16				3,200	Wind	Several greenhouses and garage damaged.
Hill City, Kans., south of.	23	7:30 p. m.	[1] 3		2,000	Wind and hail	Property damaged; path 10 miles long.
Chamberlain, S. Dak., and vicinity.	23	7:30–8:30 p. m.			13,000	High wind and heavy rain.	Electric lines, 3,000 feet of railroad trackage, and highway a mile east of Chamberlain damaged. Basements flooded. Property damage, $10,000; crop loss, $3,000.
Andover, S. Dak., 7½ miles north.	23	9:50 p. m.		0	53,000	Tornado	Path narrow and from northwest to southeast with buildings scattered to northwest to southeast of path. About 50 small buildings damaged; some livestock and poultry killed. Property damage, $50,000; crop loss, $3,000.
Hill City, Kans., 8 miles northeast.	23	P. m.		0	4,500	do	Damage to buildings on 1 farm where large barn was completely destroyed; small buildings damaged.
Verdel, Nebr., 4 miles northwest.	23	do	[1] 3		3,000	Hail and heavy rain.	Hail damage, $1,000; flood damage to bridges and fields about $2,000.
Mitchell, S. Dak., and vicinity.	24	8 p. m.	100		5,000	Wind, rain, and hail.	Brick farm building wrecked, others damaged. Telephone poles down; trees stripped of foliage; 1 person slightly injured. Property damage, $3,000; crop loss, $2,000.
Mesa, Colo., and vicinity	25	7:30 p. m.			800	Heavy hail	Storm severe on 4 ranches; loss to fruit and truck.
Kiowa, Colo.	25	P. m.	[1] 1–2		4,000		Large hailstones; property damaged.
Cumberland, Md.	25				8,000	Heavy rain	Property damaged.
Genesso, Kans., 3 miles south.	26	9:40 a. m.	[1] 1		3,000	Tornadic wind	Damage to farm property; path 3 miles long.
Scott City, Kans., north of.	26	5–5:30 p. m.	[1] 1		8,000	Heavy hail	Hailstones accumulated 6 to 7 inches deep on the level. Property damage; loss to crops; path 3 miles long.
Anthony, Kans., vicinity of.	26	8 p. m.	33	0	3,000	Small tornado	Tornado occurred in connection with general thunderstorm conditions and struck barn and outbuildings of a farm 8 miles west and 1 mile north of Anthony.
Blackstone, Ill.	26				6,000	Wind	Property damage, $3,500; crop loss, $2,500.
Bradford, Ill.	26				2,300	do	Crop loss, $1,500; property damage, $800.
Carlinville, Ill.	27				1,500	Electrical	Barn burned.
Decatur, Ill.	27				2,500	Wind	Property damaged.
Ogallala, Nebr.	28	6 p. m.	[1] 2		1,000	Wind and hail	Property damaged; loss in livestock.
Tulsa, Okla.	28	1:15–1:27 p. m.	[1] 1		10,000	Hail	Property damaged; path 2 miles long.
Kent County, Del.	31	P. m.		1	50,000	Heavy thunderstorm and flood.	Lake Como overflowed, washing out 2 bridges on the Du Pont Highway and parts of the Pennsylvania Railroad roadbed. A telephone lineman drowned.
Frederick County, Md.	31				75,000–100,000	Heavy thunderstorms.	Storm caused streams, already swollen from daily rains for a week to overflow their banks. Carroll Creek which flows southward through Frederick, reached an unprecedented crest and overflowed its banks and retaining walls for the first time in history. Merchandise in warehouses and stores damaged. Water reached to the tops of automobiles on municipal parking lot and entered many cellars. A concrete bridge and a trestle washed out.

SOLAR RADIATION AND SUNSPOT DATA FOR AUGUST 1940

SOLAR RADIATION OBSERVATIONS

By Helen Cullinane

Measurements of solar radiant energy received at the surface of the earth are made at nine stations maintained by the Weather Bureau, and at 10 cooperating stations maintained by other institutions. The intensity of the total radiation from sun and sky on a horizontal surface is continuously recorded (from sunrise to sunset) at all these stations by self-registering instruments; pyrheliometric measurements of the intensity of direct solar radiation at normal incidence are made at frequent intervals on clear days at three Weather Bureau stations (Washington, D. C., Madison, Wis., Lincoln, Nebr.) and at the Blue Hill Observatory at Harvard University. Occasional observations of sky polarization are taken at the Weather Bureau stations at Washington and Madison.

The geographic coordinates of the stations, and descriptions of the instrumental equipment, station exposures, and methods of observation, together with summaries of the data obtained, up to the end of 1936, will be found in the MONTHLY WEATHER REVIEW, December 1937, pp. 415 to 441; further descriptions of instruments and methods are given in Weather Bureau Circular Q.

Table 1 contains the measurements of the intensity of direct solar radiation at normal incidence, with means and their departures from normal (means based on less than 3 values are in parentheses). At Lincoln the observations are made with the Marvin pyrheliometer; at Washington, Madison, and Blue Hill they are obtained with a recording thermopile, checked by observations with a Smithsonian silver-disk pyrheliometer at Washington and Blue Hill. The table also gives vapor pressures at 7:30 a. m. and at 1:30 p. m. (75th meridian time).

Table 2 contains the average amounts of radiation received daily on a horizontal surface from both sun and sky during each week, their departures from normal and the accumulated departures since the beginning of the year. The values at most of the stations are obtained from the records of the Eppley pyrheliometer recording on either a microammeter or a potentiometer.

Direct solar radiant energy averaged below normal at Washington, and above normal at Lincoln and Madison. There were comparatively few measurements during August, because of the large number of cloudy days.

The total solar and sky radiation was practically normal at all stations, except at Fairbanks, where there was an excess.

Polarization measurements made at Madison on 4 days give a mean of 55.8, compared with a normal for August of 58 percent, while the maximum was 65.1 on the 20th.

TABLE 1.—*Solar radiation intensities during August 1940*

[Gram-calories per minute per square centimeter of normal surface]

WASHINGTON, D. C.

Date	Sun's zenith distance: 7:30 a. m.	78.7°	75.7°	70.7°	60.0°	0.0°	60.0°	70.7°	75.7°	78.7°	1:30 p. m.
	75th mer. time	Air mass: A. M.				P. M.					Local mean solar time
	e	5.0	4.0	3.0	2.0	*1.0	2.0	3.0	4.0	5.0	e
	Mm.	*Cal.*	*Cal.*	*Cal.*	*Cal.*	*Cal.*	*Cal.*	*Cal.*	*Cal.*	*Cal.*	*Mm.*
August 2	11.81		0.42	0.61	0.84						11.81
August 9	14.97	0.23	.35	.45	.67						12.24
August 10	15.11	.25	.42	.53	.72						12.68
August 20	13.61	.42	.53	.65	.81	1.04					15.65
August 25	18.59		.53	.63	.71						8.48
Means		.30	.45	.57	.75	(1.04)					
Departures		−.31	−.22	−.18	−.18	−.20					
MADISON, WIS.											
August 7	9.83	0.65	0.74	0.81	1.02	1.44					9.14
August 20	7.87		1.03	1.11	1.31	1.51					6.76
August 21	9.47		.79	.95	1.16	1.30					14.60
August 23	7.29		.95	1.03	1.13						6.76
August 30	10.59				.96	1.34					12.24
Means		(.65)	.88	.98	1.12	1.40					
Departures		−.07	+.07	+.04	+.02	+.07					
LINCOLN, NEBR.											
August 6	10.59		0.88	1.02	1.20	1.44	1.18	1.06	0.94		10.59
August 15	16.20		.87	1.01							17.96
August 19	7.87			.89	1.14	1.44					9.14
August 30	9.83					1.26	.99	.79	.63		8.48
August 31	8.18				1.21	1.48					8.48
Means			(.88)	.97	1.18	1.40	(1.08)	(.98)	(.78)		
Departures			+.10	+.06	+.09	+.08	+.01	+.10	+.03		

* Extrapolated.

TABLE 2.—*Average daily totals of solar radiation (direct + diffuse) received on a horizontal surface*

[Gram-calories per square centimeter]

Week beginning—	Washington	Madison	Lincoln	Chicago	New York	Fresno	Albuquerque	Fairbanks	Twin Falls	La Jolla	Miami	New Orleans	Riverside	Blue Hill	Newport	Friday Harbor	Ithaca	Cambridge
	cal.	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*
July 30	644	512	549	471	583	697	670	408		588	443	360	621	533	596			592
Aug. 6	520	492	445	452	474	656	542	354		510	483	392	576	503	492			553
Aug. 13	306	371	507	313	328	653	621	407		497	458	511	564	473	477			515
Aug. 20	452	400	462	361	367	618	608	375		510	391	468	537	499	508			493
Aug. 27	318	345	417	343	177	536	618	255		404	416	520		360	354			380
DEPARTURES FROM WEEKLY NORMALS																		
July 30	+157	+35	+23	+57	+143	+27		+57		+37	−32	−32	+53	+2	+54			
Aug. 6	+71	+32	−55	+46	+93	+11		+35		−5	−3	−2	+38	−4	−22			
Aug. 13	−133	−73	+14	−89	−45	+22		+101		+22	−7	+136	+31	−32	−11			
Aug. 20	+32	−43	−29	−53	+29	+20		+87		−2	−69	+80	+23	+30	+46			
Aug. 27	−100	−63	−27	+2	−169	−41		+12		−62	−41	+109		−44	−71			
ACCUMULATED DEPARTURES ON SEPT. 3, 1940																		
	+4,046	+3,178	−1,449	+3,528	+6,321	−616		+4,683		−4,641	+588	+7,611		−4,473	−2,447			

POSITIONS, AREAS, AND COUNTS OF SUN SPOTS

[Communicated by Capt. J. F. Hellweg, U. S. Navy (Ret.), Superintendent, U. S. Naval Observatory.] All measurements and spot counts were made at the Naval Observatory from plates taken at the observatories indicated. Difference in longitude is measured from the central meridian, positive toward the west. Latitude is positive toward the north. Areas are corrected for foreshortening and expressed in millionths of Sun's hemisphere. For each day, under longitude, latitude, area of spot or group, and spot count, are included assumed longitude of center of the disk, assumed latitude of center of the disk, total area of spots and groups, and total spot count.

Date	Eastern standard time	Mount Wilson group No.	Heliographic				Area of spot or group	Spot count	Plate quality	Observatory
			Difference in longitude	Longitude	Latitude	Distance from center of disk				
1940	h m		°	°	°	°				
Aug. 1...	10 55	(*)	−64	175	−5	66	12	4	VG	U. S. Naval.
		6924	−37	202	+19	40	291	14		
		6924	−29	210	+18	31	339	12		
		6925	−13	226	−12	22	97	13		
		6923	+14	253	−9	21	194	1		
		6926	+16	255	+8	16	48	1		
		6926	+20	259	+8	20	73	3		
		6921	+39	278	−8	42	48	5		
				(239)	(+6)		1,102	53		
Aug. 2...	10 50	6924	−24	201	+19	27	218	11	G	Do.
		6924	−16	209	+18	20	315	9		
		6925	0	225	−12	18	48	10		
		6923	+28	253	−9	32	218	1		
		6926	+34	259	+8	34	61	3		
		6921	+51	276	−8	54	61	6		
				(225)	(+6)		921	40		
Aug. 3...	10 45	6931	−82	130	+11	82	12	1	G	Do.
		6930	−80	132	−12	80	485	4		
		6928	−68	144	+15	68	6	1		
		6929	−66	146	+1	67	12	1		
		6924	−10	202	+19	16	206	10		
		6924	−6	206	+16	11	12	1		
		6924	−2	210	+18	13	267	3		
		6927	+4	216	+9	5	24	6		
		6925	+11	223	−12	20	24	8		
		6923	+41	253	−10	45	206	2		
		6926	+48	260	+7	48	48	4		
		6921	+65	277	−7	68	24	2		
				(212)	(+6)		1,326	43		
Aug. 4...	12 2	6931	−68	130	+10	68	24	1	VG	Do.
		6930	−67	131	−13	70	533	12		
		6928	−57	141	+13	57	194	13		
		6929	−50	148	+1	51	24	2		
		6935	−9	189	−19	26	6	1		
		6924	+4	202	+19	14	170	18		
		6924	+11	209	+18	16	267	5		
		6923	+56	254	−9	59	194	1		
		6933	+60	258	+8	60	61	4		
		6932	+61	259	−8	63	6	1		
		6926	+64	262	+7	64	36	4		
		6921	+77	275	−7	78	12	1		
				(198)	(+6)		1,527	63		
Aug. 5...	11 27	6936	−88	97	+7	88	48	1	G	Do.
		6930	−56	129	−12	60	48	1		
		6930	−53	132	−13	56	679	18		
		6931	−53	132	+10	53	24	1		
		6928	−43	142	+13	43	242	15		
		6929	−38	147	+2	39	12	1		
		6924	+17	202	+22	23	48	10		
		6924	+18	203	+19	22	145	13		
		6924	+23	208	+18	26	218	4		
		6923	+69	254	−9	70	242	8		
		6933	+71	256	+9	71	242	5		
		6932	+75	260	−8	77	194	2		
		6926	+75	260	+8	75	194	4		
				(185)	(+6)		2,336	83		
Aug. 6...	11 9	6938	−80	92	+5	80	145	9	F	Do.
		6936	−75	97	+7	75	97	1		
		(*)	−75	97	+2	76	12	1		
		6930	−39	133	−13	44	679	20		
		6931	−39	133	+11	39	24	1		
		6937	−37	135	−14	42	6	3		
		6928	−29	143	+13	30	242	19		
		6934	+20	192	+10	21	24	1		
		6924	+30	202	+20	33	218	10		
		6924	+37	209	+18	39	218	2		
		6923	+85	257	−9	85	97	2		
		6933	+88	260	+8	88	48	1		
				(172)	(+6)		1,810	70		
Aug. 7...	11 22	6938	−67	92	+5	67	582	19	G	Do.
		6936	−60	99	+6	60	97	1		
		6937	−51	108	−14	56	97	1		
		6931	−26	133	+11	27	12	1		
		6930	−25	134	−13	31	727	35		
		6928	−16	143	+13	18	194	25		
		6924	+43	202	+20	45	182	7		
		6924	+50	209	+18	51	194	3		
				(159)	(+6)		2,085	92		

POSITIONS, AREAS, AND COUNTS OF SUN SPOTS—Con.

Date	Eastern standard time	Mount Wilson group No.	Heliographic				Area of spot or group	Spot count	Plate quality	Observatory
			Difference in longitude	Longitude	Latitude	Distance from center of disk				
1940	h m		°	°	°	°				
Aug. 8...	10 34	6938	−54	92	+5	54	679	21	VG	U. S. Naval.
		6936	−47	99	+6	47	97	1		
		6937	−37	109	−13	42	339	30		
		6931	−15	131	+11	16	24	6		
		6930	−12	134	−13	22	679	50		
		6928	−3	143	+13	8	145	16		
		6924	+55	201	+20	57	145	5		
		6924	+62	208	+18	63	194	2		
				(146)	(+6)		2,302	131		
Aug. 9...	10 49	6938	−39	94	+5	39	727	39	VG	Do.
		6936	−33	100	+6	33	97	1		
		6937	−23	110	−13	30	388	52		
		6931	−2	131	+12	6	12	3		
		6930	+1	134	−13	19	533	40		
		6928	+11	144	+14	15	145	22		
		6924	+69	202	+20	69	121	5		
		6924	+76	209	+18	76	145	3		
				(133)	(+6)		2,168	165		
Aug. 10..	10 54	6941	−86	34	+12	86	339	1	VG	Do.
		6940	−82	38	−14	83	6	1		
		6938	−25	95	+5	25	776	40		
		6936	−19	101	+6	19	97	3		
		6937	−10	110	−14	22	145	32		
		6939	−7	113	−5	13	6	4		
		6937	−5	115	−13	20	364	8		
		6930	+16	136	−12	23	242	40		
		6928	+25	145	+15	27	145	21		
		6924	+83	203	+20	83	145	1		
				(120)	(+6)		2,265	151		
Aug. 11..	8 55	6942	−84	23	+17	84	48	2	VG	Mt. Wilson.
		6941	−72	35	+13	72	194	2		
		6940	−69	38	−13	71	145	14		
		6938	−12	95	+6	12	776	55		
		6936	−7	100	+6	7	61	1		
		6937	+2	109	−13	19	291	44		
		6937	+8	115	−12	20	485	10		
		6930	+29	136	−12	35	388	30		
		6928	+35	142	+18	37	24	12		
		6928	+39	146	+15	40	73	15		
				(107)	(+6)		2,485	185		
Aug. 12..	15 26	6942	−70	21	+15	71	12	2	VG	U. S. Naval.
		6941	−56	35	+13	56	255	6		
		6940	−53	38	−13	56	315	16		
		6938	+3	94	+6	3	727	41		
		6936	+10	101	+6	10	48	1		
		6937	+18	109	−13	27	97	45		
		6937	+23	114	−12	30	582	5		
		6930	+43	134	−13	48	436	28		
		6928	+50	141	+17	50	133	19		
		6928	+58	149	+14	58	12	4		
				(91)	(+7)		2,617	167		
Aug. 13..	10 57	6943	−79	1	−19	80	121	1	F	Do.
		6942	−59	21	+14	59	12	2		
		6941	−44	36	+13	44	242	3		
		6940	−41	39	−13	46	630	21		
		6938	+14	94	+6	14	679	20		
		6936	+20	100	+6	20	48	1		
		6937	+30	110	−13	37	97	21		
		6937	+35	115	−12	40	582	3		
		6930	+53	133	−13	57	364	13		
		6928	+61	141	+17	61	145	7		
				(80)	(+7)		2,920	98		
Aug. 14..	8 44	6943	−64	4	−18	69	145	1	VG	Mt Wilson.
		6941	−31	37	+14	32	218	3		
		6940	−30	38	−13	37	727	29		
		6938	+27	95	+6	27	679	35		
		6936	+33	101	+6	33	48	1		
		6937	+43	111	−13	48	121	35		
		6937	+49	117	−12	52	533	4		
		6930	+67	135	−13	69	364	17		
		6928	+74	142	+17	74	145	14		
				(68)	(+7)		2,980	139		
Aug. 15	8 43	6943	−52	3	−18	58	145	1	VG	Do.
		6941	−19	36	+14	20	194	3		
		6940	−18	37	−13	28	727	29		
		6938	+40	95	+6	40	679	30		
		6936	+47	102	+6	47	36	1		
		6937	+56	111	−13	60	97	22		
		6937	+63	118	−12	67	533	4		
		6930	+80	135	−13	82	145	5		
		6928	+87	142	+17	87	48	3		
				(55)	(+7)		2,604	98		
Aug. 16	8 46	6946	−78	323	−10	79	48	1	VG	Do.
		6945	−58	343	+9	58	97	15		
		6943	−39	2	−18	45	194	5		

POSITIONS, AREAS, AND COUNTS OF SUN SPOTS—Con.

Date	Eastern standard time	Mount Wilson group No.	Heliographic: Difference in longitude	Heliographic: Longitude	Heliographic: Latitude	Heliographic: Distance from center of disk	Area of spot or group	Spot count	Plage quality	Observatory
1940	h m		°	°	°	°				
Aug. 16	8 46	6944	−18	23	−15	29	24	7	VG	Mt. Wilson.
		6940	−10	31	−13	23	73	25		
		6941	−6	35	+14	10	194	2		
		6940	−2	39	−13	20	703	25		
		6938	+54	95	+6	54	630	30		
		6936	+59	100	+6	59	24	1		
		6937	+69	110	−13	71	97	15		
		6937	+77	118	−13	79	679	10		
				(41)	(+7)		2,763	136		
Aug. 17	10 25	6948	−68	319	−6	70	12	3	VG	U. S. Naval.
		6946	−63	324	−10	66	6	1		
		6945	−44	343	+8	44	582	35		
		6943	−23	4	−19	34	170	3		
		6943	−20	7	−17	32	6	1		
		(*)	−8	19	+12	10	6	6		
		6944	−4	23	−13	20	12	5		
		6944	+4	31	−13	20	24	13		
		6941	+4	31	+13	7	12	7		
		6941	+8	35	+13	11	194	2		
		6938	+68	95	+6	68	533	27		
		6947	+74	101	−3	75	24	4		
				(27)	(+7)		1,581	107		
Aug. 18	14 14	6948	−55	317	−5	57	36	4	P	Mt. Wilson.
		6945	−29	343	+10	29	582	22		
		6943	−10	2	−17	26	145	2		
		6941	+23	35	+13	24	194	4		
		6940	+26	38	−13	33	533	12		
		6949	+75	87	−14	78	48	3		
		6938	+86	98	+6	89	194	3		
				(12)	(+7)		1,732	50		
Aug. 19	14 42	(*)	−54	305	−19	60	6	1	VG	U. S. Naval.
		6950	−53	306	+11	57	48	3		
		6948	−41	318	−6	43	6	1		
		6945	−15	344	+9	15	727	45		
		6943	+5	4	−18	26	145	11		
		6941	+38	37	+12	38	145	1		
		6940	+40	39	−13	45	582	15		
				(359)	(+7)		1,659	77		
Aug. 20..	11 34	6956	−81	266	+6	81	242	2	G	Do.
		6955	−80	267	−10	81	242	1		
		6956	−78	269	+4	78	194	5		
		6954	−42	305	−18	49	121	15		
		6950	−41	306	+11	41	36	4		
		6948	−28	319	−7	32	12	3		
		6953	−19	328	−9	25	6	2		
		6945	−4	343	+9	4	727	45		
		6943	+11	358	−20	29	12	3		
		6943	+17	4	−18	31	61	5		
		6952	+29	16	−17	38	12	4		
		6951	+38	25	+12	38	12	4		
		6941	+50	37	+12	50	194	2		
		6940	+51	38	−13	55	679	3		
				(347)	(+7)		2,550	98		
Aug. 21..	11 0	6958	−77	257	+8	79	194	5	G	Do.
		6957	−75	259	−9	77	145	2		
		6956	−68	266	+6	68	145	8		
		6955	−66	268	−10	68	436	4		
		6956	−65	269	+4	65	97	5		
		6954	−28	306	−18	38	121	5		
		6950	−27	307	+12	28	24	2		
		6948	−14	320	−7	20	12	2		
		6945	+10	344	+8	10	679	45		
		6943	+30	4	−18	39	48	3		
		6952	+43	17	−16	48	24	6		
		6941	+63	37	+12	63	194	1		
		6940	+64	38	−13	68	679	3		
				(334)	(+7)		2,798	86		
Aug. 22..	11 36	6957	−60	252	−11	70	12	1	G	Do.
		6958	−63	258	+8	63	97	5		
		6957	−61	260	−9	64	61	3		
		6956	−55	266	+6	55	73	4		
		6955	−51	270	−9	54	242	2		
		6956	−50	271	+4	50	73	3		
		6954	−17	304	−18	31	145	16		
		6950	−13	308	+12	14	73	19		
		6954	−12	309	−18	28	12	10		
		6948	0	321	−7	15	12	2		
		6953	+5	326	−8	16	12	4		
		6945	+25	346	+8	25	533	41		
		6943	+45	6	−17	50	24	3		
		6941	+76	37	+12	76	145	3		
		6940	+78	39	−13	80	679	3		
				(321)	(+7)		2,193	119		

POSITIONS, AREAS, AND COUNTS OF SUN SPOTS—Con.

Date	Eastern standard time	Mount Wilson group No.	Heliographic: Difference in longitude	Heliographic: Longitude	Heliographic: Latitude	Heliographic: Distance from center of disk	Area of spot or group	Spot count	Plage quality	Observatory
1940	h m		°	°	°	°				
Aug. 23..	11 16	6958	−49	259	+8	49	48	6	G	U. S. Naval.
		6957	−47	261	−9	50	61	1		
		6956	−41	267	+6	41	48	8		
		6955	−39	269	−10	42	291	4		
		6956	−37	271	+4	38	73	8		
		6950	−8	300	+12	10	97	15		
		6954	−3	305	−18	25	61	10		
		6950	+1	309	+12	5	48	5		
		6954	+4	312	−17	25	12	3		
		6953	+14	322	−11	23	36	7		
		6945	+37	345	+8	37	194	28		
		6945	+44	352	+5	44	291	4		
		6959	+47	355	+12	47	61	8		
		6943	+58	6	−17	62	6	1		
				(308)	(+7)		1,327	108		
Aug. 24..	11 27	6958	−35	259	+8	35	12	3	G	Do.
		6957	−34	260	−9	38	61	5		
		6956	−28	266	+5	28	36	10		
		6955	−24	270	−9	25	242	4		
		6956	−24	270	+4	25	48	6		
		6954	+10	304	−17	26	24	7		
		6950	+15	309	+12	16	48	6		
		6954	+17	311	−17	31	24	4		
		6953	+30	324	−12	36	24	6		
		6945	+49	343	+9	49	97	13		
		6945	+57	351	+5	57	242	10		
		6959	+63	357	+11	63	48	1		
				(294)	(+7)		906	75		
Aug. 25..	9 40	6957	−20	262	−7	25	73	1	G	Mt. Wilson.
		6958	−20	262	+8	20	36	8		
		6956	−16	266	+5	16	24	5		
		6955	−11	271	−7	18	267	5		
		6961	−7	275	+3	8	6	1		
		6960	−2	280	−15	22	12	3		
		6954	+27	309	−16	36	48	9		
		6950	+29	311	+12	30	36	3		
		6953	+45	327	−12	49	24	4		
		6945	+62	344	+7	62	97	20		
		6945	+71	353	+4	71	242	1		
		6959	+78	0	+9	78	73	4		
				(282)	(+7)		938	64		
Aug. 26..	9 36	6965	−81	188	−7	82	242	6	G	Do.
		6963	−43	226	+11	43	12	1		
		6957	−6	263	−8	16	73	3		
		6956	−2	267	+9	3	73	12		
		6956	+2	271	+6	2	24	9		
		6955	+3	272	−8	16	242	5		
		6960	+12	281	−15	25	12	2		
		6954	+45	314	−17	51	73	15		
		6953	+55	324	−12	59	12	4		
		6945	+76	345	+7	76	121	16		
		6945	+85	354	+5	85	242	1		
				(269)	(+7)		1,126	74		
Aug. 27..	9 49	6967	−73	182	+15	74	48	2	F	Do.
		6965	−67	188	−7	69	242	10		
		6964	−54	201	+19	54	24	2		
		6966	−43	212	+8	43	24	7		
		6957	+8	263	−8	17	73	10		
		6956	+10	265	+6	10	24	5		
		6955	+13	268	−8	20	242	13		
		6954	+58	313	−17	62	218	25		
				(255)	(+7)		895	74		
Aug. 28..	9 50	6967	−60	182	+17	60	121	12	P	Do.
		6965	−53	189	−6	53	436	17		
		6966	−31	211	+8	31	24	3		
		6962	−1	241	−8	15	36	7		
		6957	+21	263	−9	26	48	3		
		6955	+29	271	−9	33	194	1		
		6954	+69	311	−17	71	194	3		
		6954	+74	316	−18	77	291	2		
				(242)	(+7)		1,344	48		
Aug. 29..	9 44	6969	−81	148	+11	81	194	4	G	Do.
		6968	−78	151	+18	79	145	2		
		6967	−47	182	+16	47	242	16		
		6965	−37	192	−7	40	630	38		
		6962	+13	242	−7	20	73	12		
		6957	+37	266	−9	41	36	2		
		6955	+43	272	−8	47	194	1		
		6954	+85	314	−16	85	242	3		
				(229)	(+7)		1,756	78		

POSITIONS, AREAS, AND COUNTS OF SUN SPOTS—Con.

Date	Eastern standard time	Mount Wilson group No.	Heliographic: Difference in longitude	Heliographic: Longitude	Heliographic: Latitude	Heliographic: Distance from center of disk	Area of spot or group	Spot count	Plate quality	Observatory
1939	h m		°	°	°	°				
Aug. 30	13 47	6969	−70	144	+12	70	48	1	VG	Mt. Wilson.
		6969	−65	149	+10	65	291	8		
		6968	−61	153	+17	61	194	1		
		6967	−32	182	+15	33	291	16		
		6965	−21	193	−7	26	824	31		
		6962	+30	244	−9	34	36	9		
		6970	+39	253	−10	42	12	4		
		6957	+52	266	−9	55	48	1		
		6955	+59	273	−8	60	194	1		
				(214)	(+7)		1,938	72		
Aug. 31	11 4	6972	−81	121	−17	82	97	6	G	Do.
		6962	−62	140	−10	64	6	1		
		6969	−59	143	+12	59	24	7		
		6969	−51	151	+10	51	291	8		
		6968	−50	152	+16	50	145	1		
		6967	−19	183	+14	20	230	19		
		6965	−8	194	−7	16	873	44		
		*	+1	203	+20	13	6	4		
		6957	+64	266	−9	66	30	1		
		6955	+71	273	−8	73	194	1		
				(202)	(+7)		1,896	92		

Mean daily area for 30 days=1,898.

*Not numbered.
VG=very good; G=good; F=fair; P=poor.

PROVISIONAL RELATIVE SUNSPOT NUMBERS

[Dependent on observations at Zurich only. Data furnished through the courtesy of Prof. W. Brunner, Eidgen. Sternwarte, Zurich]

August 1940	Relative numbers	August 1940	Relative numbers	August 1940	Relative numbers
1	69	11	*Eacd* 128	21	
2	60	12	*a* 124	22	126
3	*d* 67	13	*d* 162	23	*a* 116
4	*Eac* 105	14	128	24	94
5	103	15	110	25	84
6	*d* 111	16	*Eac* 98	26	*Eac* 71
7	*Ec* 121	17	*a* 109	27	*d* 75
8	*a* 119	18	114	28	76
9	*a* 129	19	*Eac* 97	29	*dd* 89
10	148	20	*Eacd* 126	30	89
				31	*a* 99

Mean 30 days=104.9

a=Passage of an average sized group through the central meridian.
b=Passage of a large group through the central meridian.
c=New formation of a group developing into a middle sized or large center of activity; E, on the eastern part of the sun's disk; W, on the western part; M, in the central circle zone.
d=Entrance of a large or average sized center of activity on the east limb.

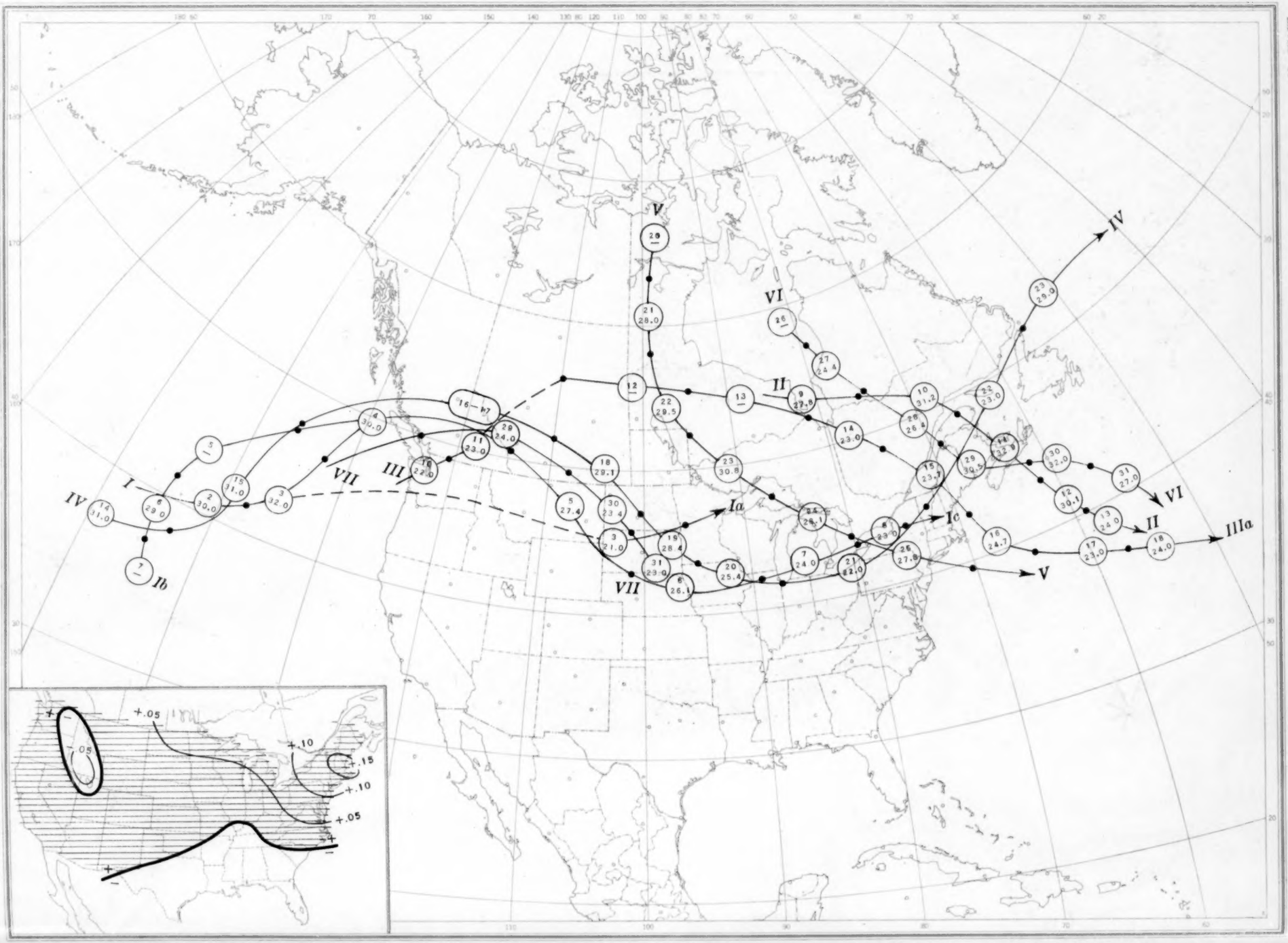
U. S. GOVERNMENT PRINTING OFFICE: 1940

Chart I. Departure (°F.) of the Mean Temperature from the Normal, and Wind Roses for Selected Stations, August 1940

Chart I. Departure (°F.) of the Mean Temperature from the Normal, and Wind Roses for Selected Stations, August 1940

HOURLY PERCENTAGES
Shaded portions show excess (+)
Unshaded portions show deficiency (−)
Lines show amount of excess or deficiency

Chart II. Tracks of Centers of Anticyclones, August 1940. (Inset) Departure of Monthly Mean Pressure from Normal

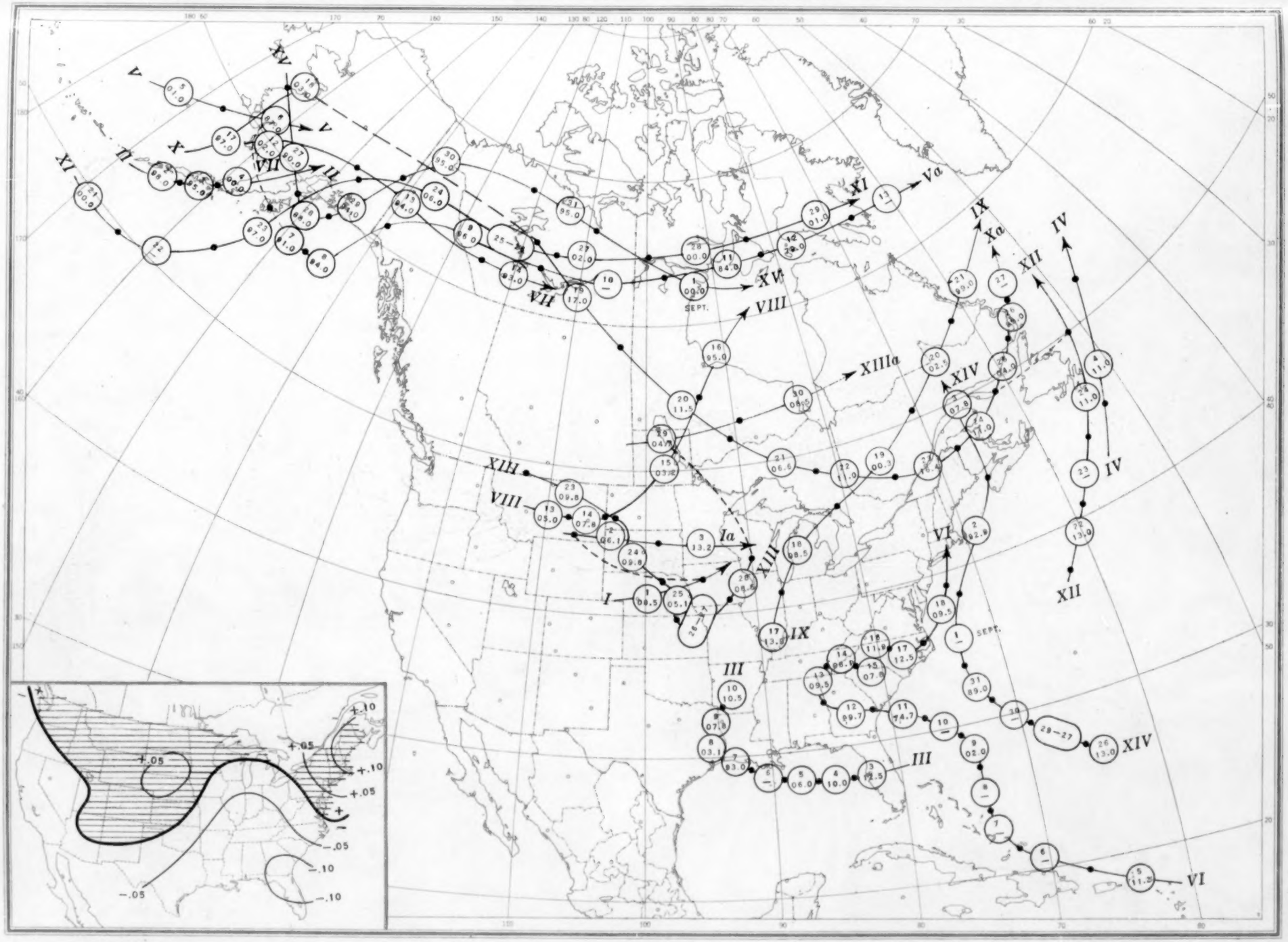


Circle indicates position of anticyclone at 7:30 a. m. (75th meridian time), with barometric reading. Dot indicates position of anticyclone at 7:30 p. m. (75th meridian time).

Chart III. Tracks of Centers of Cyclones, August 1940. (Inset) Change in Mean Pressure from Preceding Month

Circle indicates position of anticyclone at 7:30 a. m. (75th meridian time), with barometric reading. Dot indicates position of anticyclone at 7:30 p. m. (75th meridian time).

Chart III. Tracks of Centers of Cyclones, August 1940. (Inset) Change in Mean Pressure from Preceding Month



Circle indicates position of cyclone at 7:30 a. m. (75th meridian time), with barometric reading. Dot indicates position of cyclone at 7:30 p. m. (75th meridian time).

Chart IV. Percentage of Clear Sky Between Sunrise and Sunset, August 1940

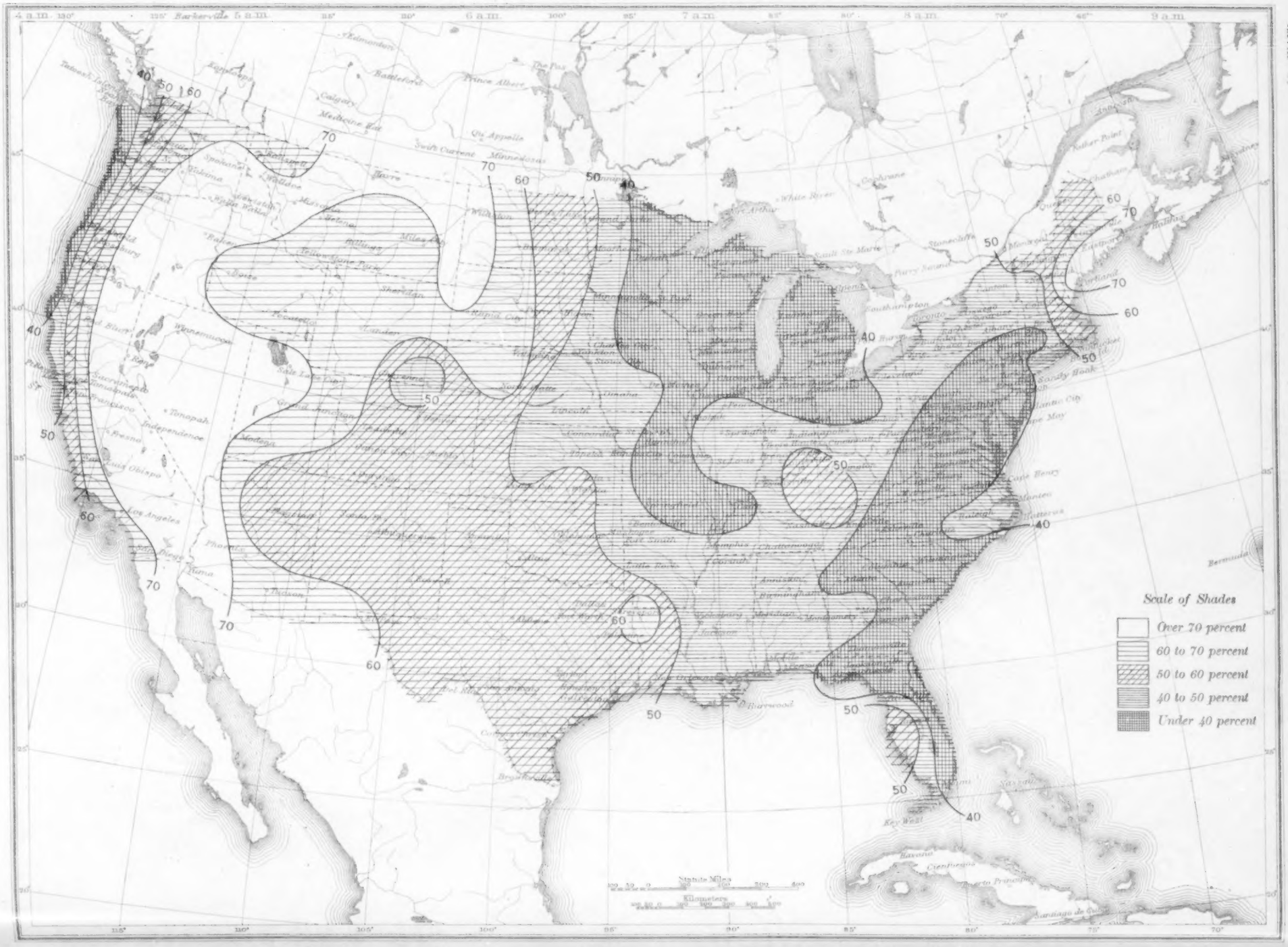


Chart V. Total Precipitation, Inches, August 1940. (Inset) Departure of Precipitation from Normal

Chart V. Total Precipitation, Inches, August 1940. (Inset) **Departure of Precipitation from Normal**

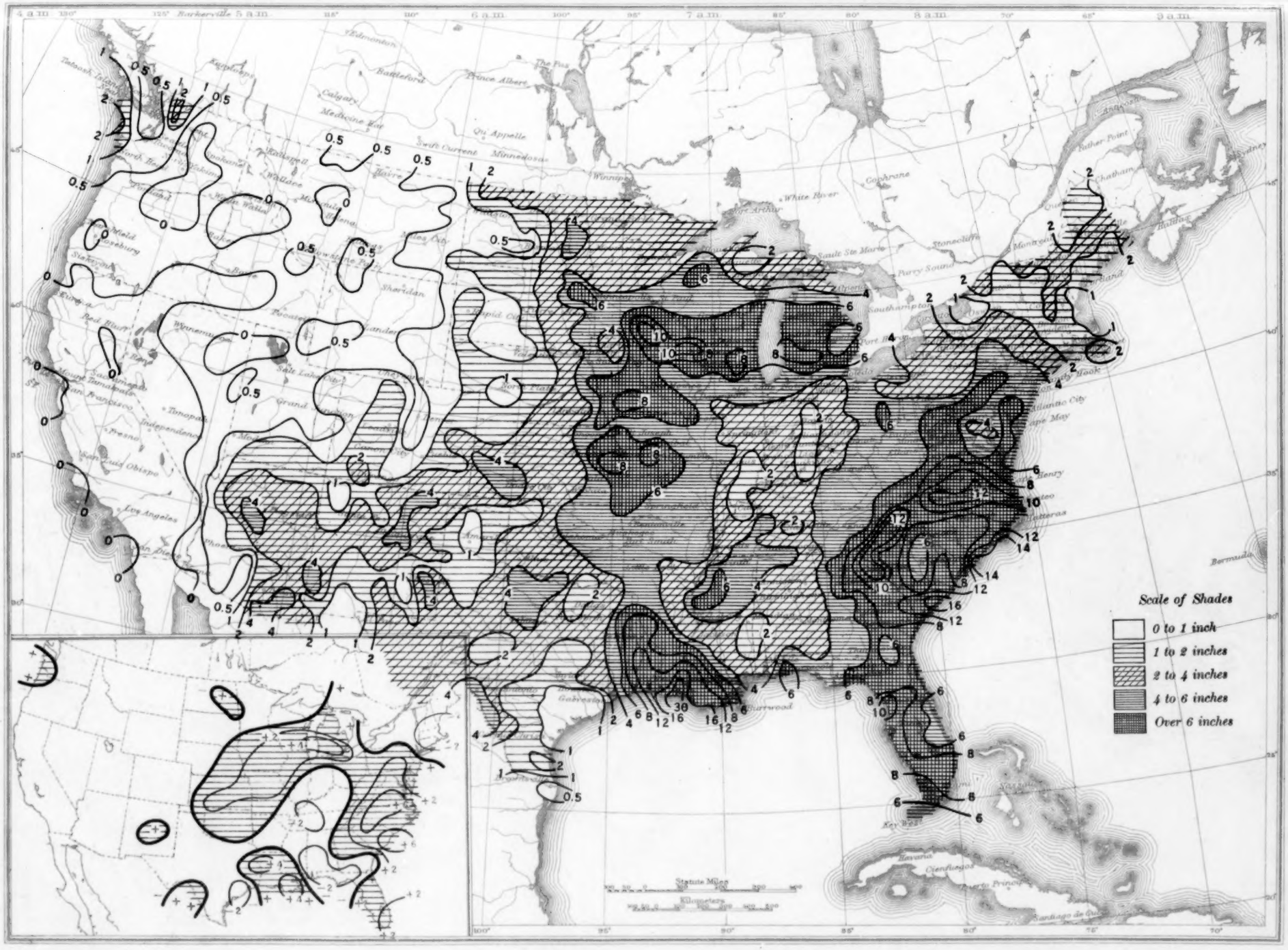


Chart VI. Isobars at Sea Level and Isotherms at Surface; Prevailing Winds, August 1940

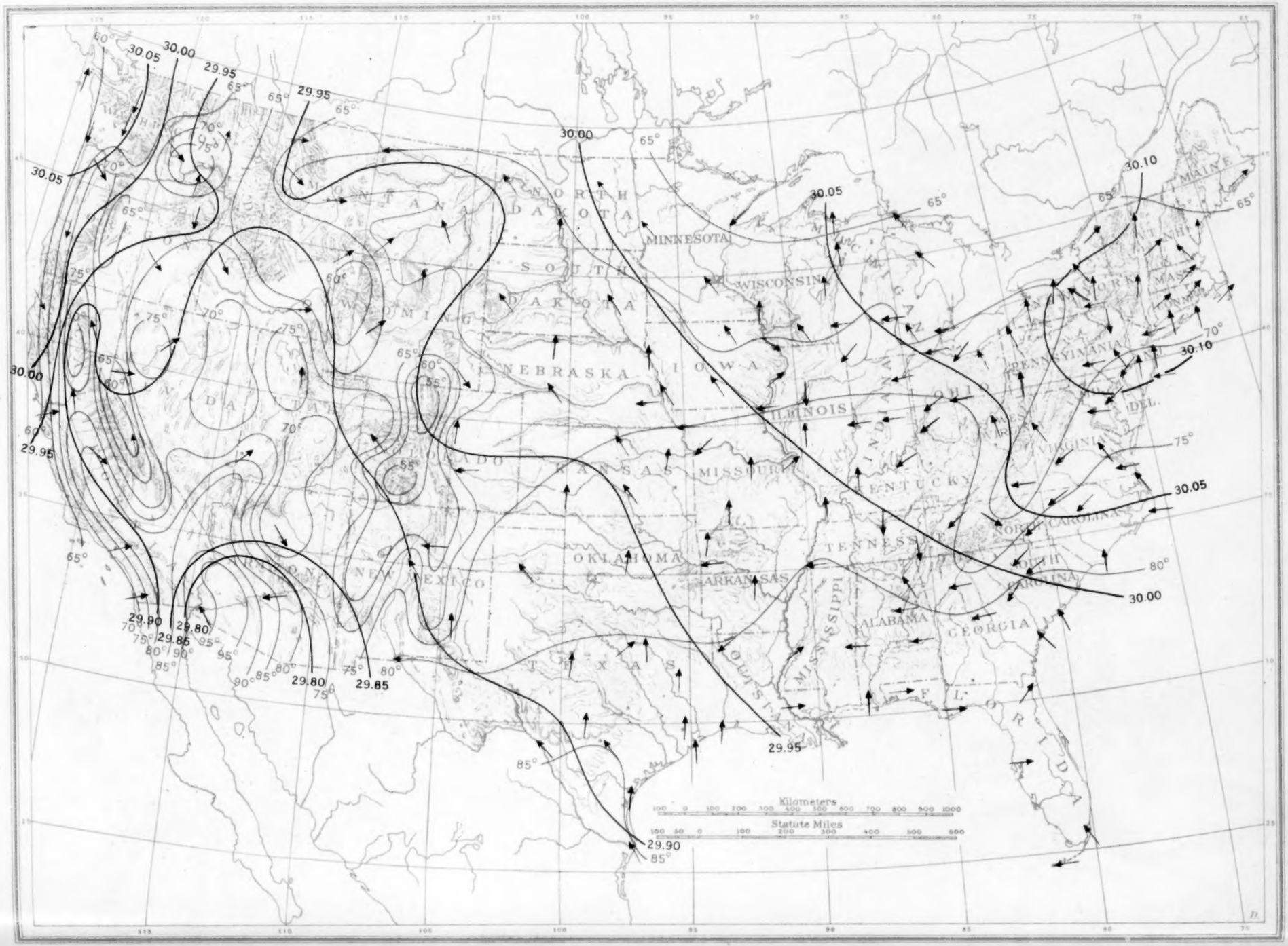


Chart VIII. Isobars (mb) for 1,524 Meters (5,000 ft.) and Isotherms (°C.) and Resultant Winds for 1,500 Meters (m. s. l.) August 1940

Chart VIII. Isobars (mb) for 1,524 Meters (5,000 ft.) and Isotherms (°C.) and Resultant Winds for 1,500 Meters (m. s. l.) August 1940

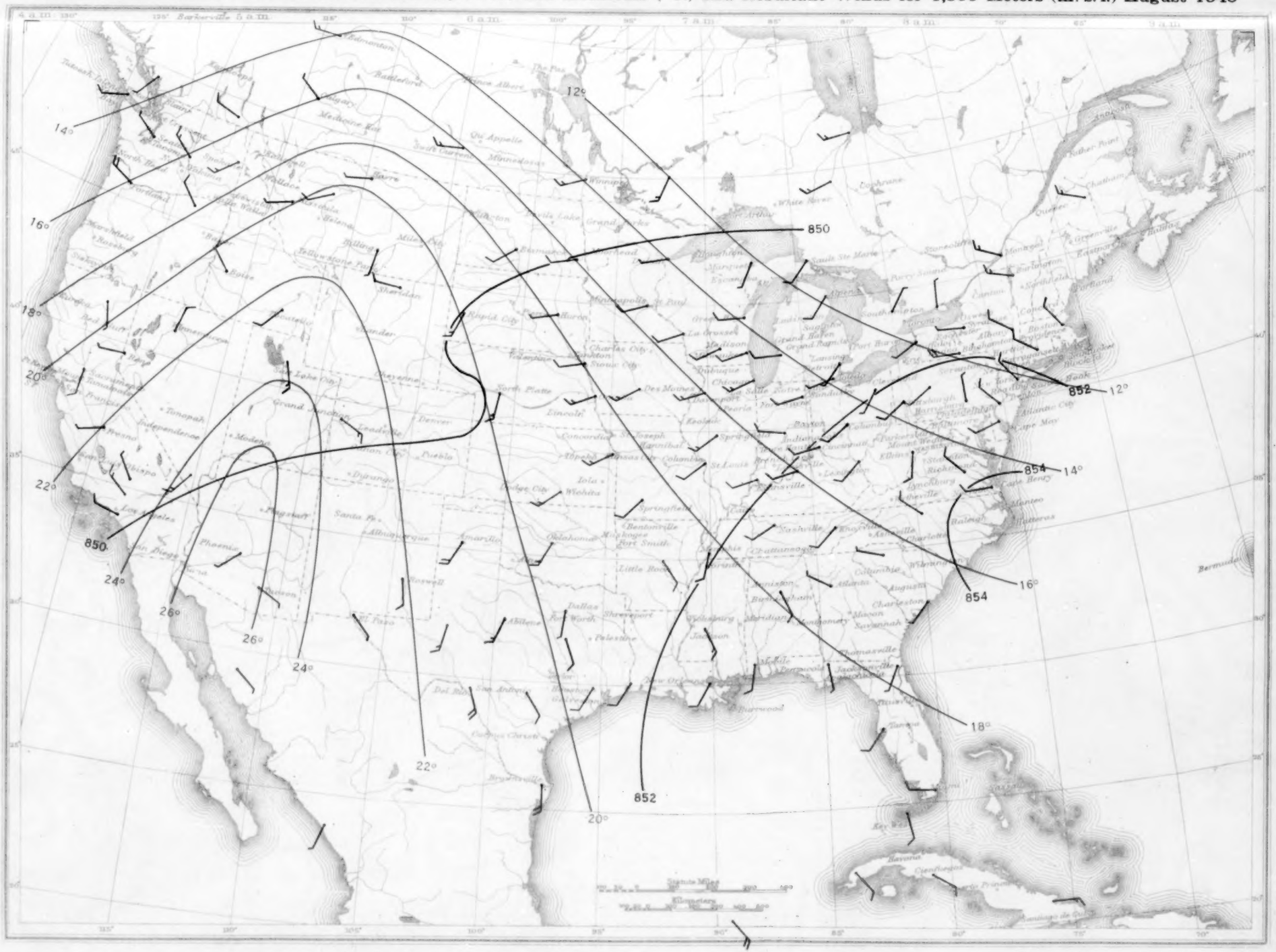


Chart IX. Isobars (mb) Isotherms (°C.) and Resultant Winds for 3,000 Meters (m. s. l.) August 1940

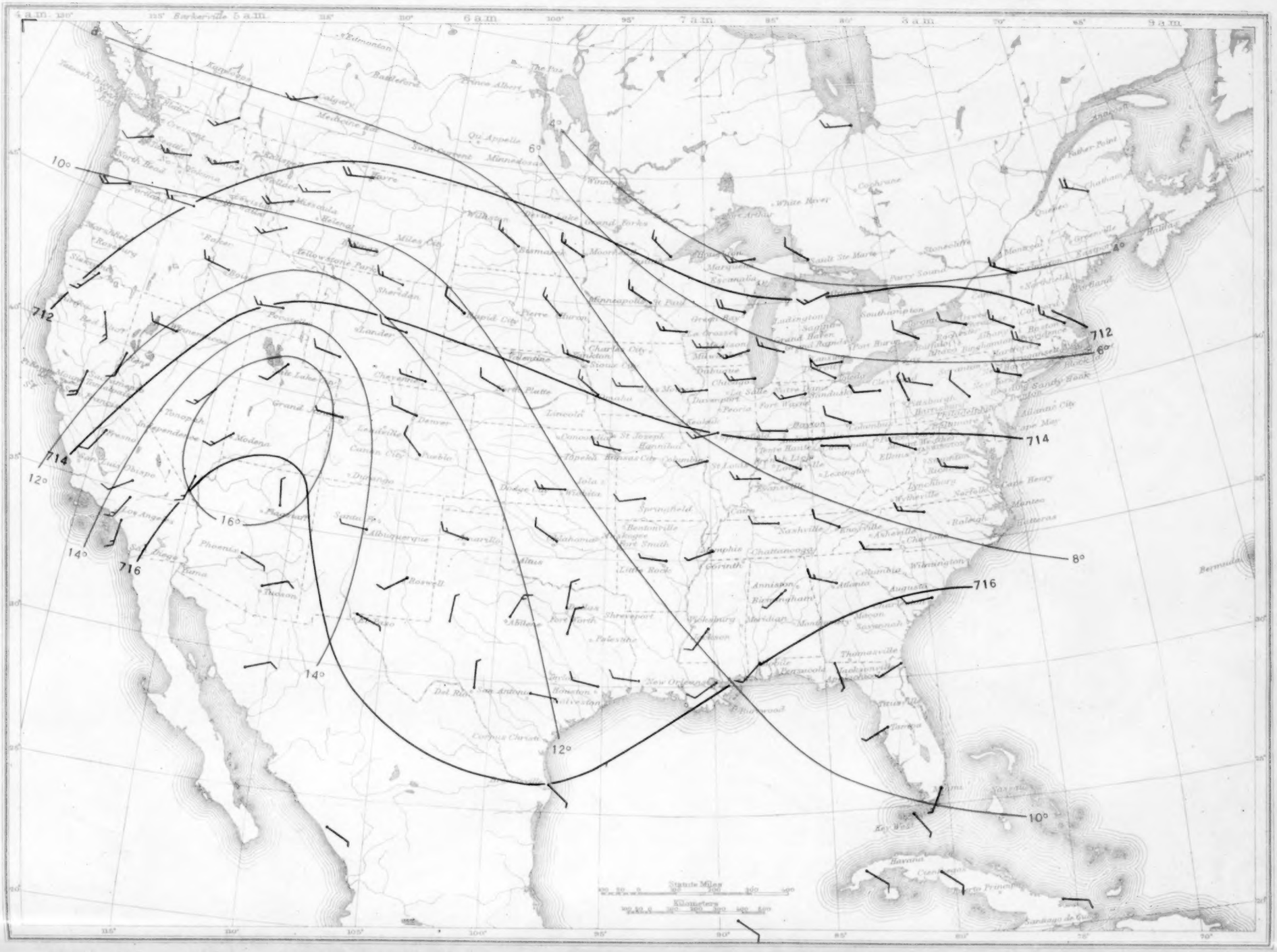


Chart X. Isobars (mb) Isotherms (°C.) and Resultant Winds for 5,000 Meters (m. s. l.) August 1940

Chart X. Isobars (mb) Isotherms (°C.) and Resultant Winds for 5,000 Meters (m. s. l.) August 1940

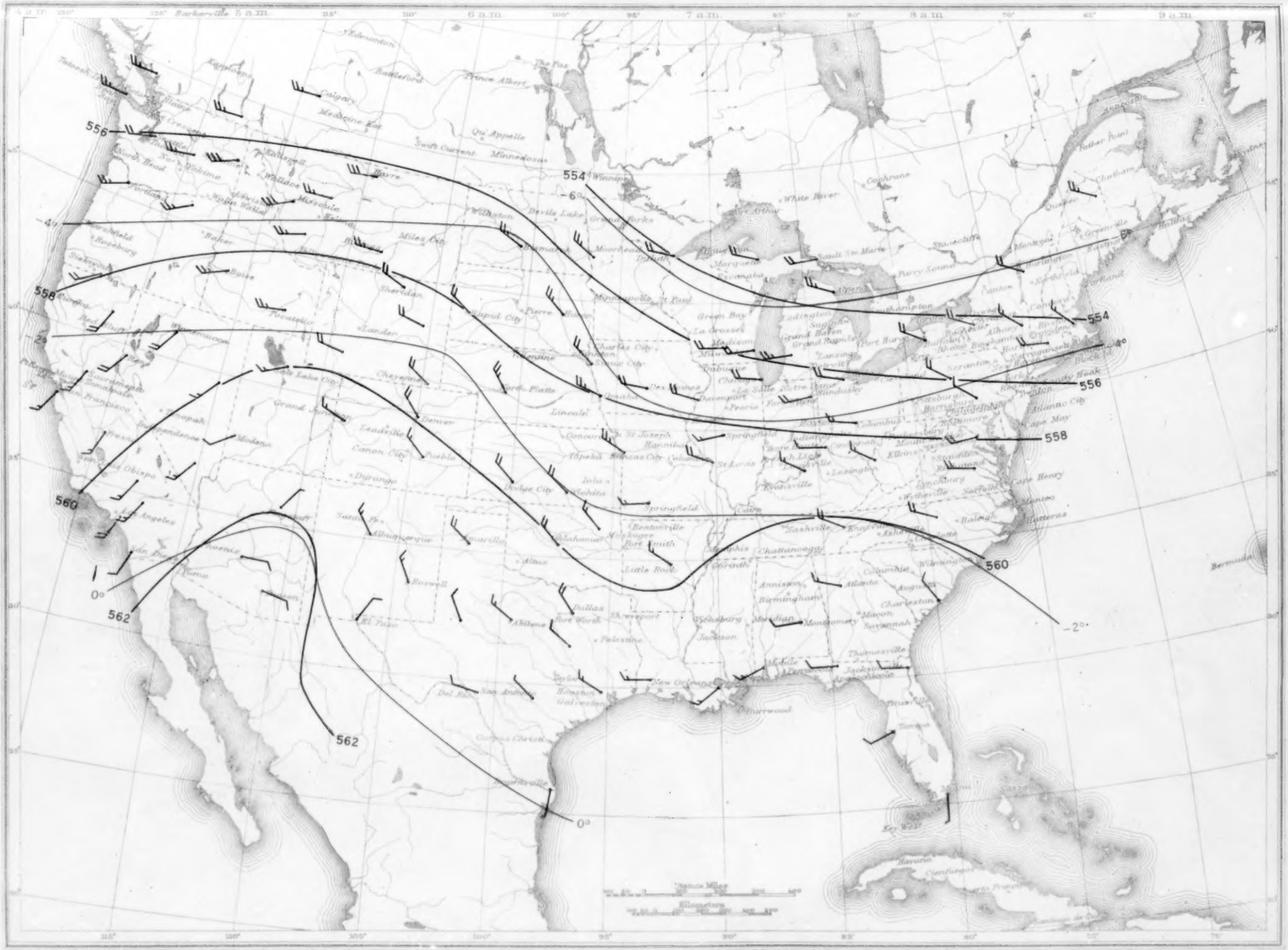


Chart XI. Isobars (mb) Isotherms (°C.) and Resultant Winds for 10,000 Meters (m. s. l.) August 1940

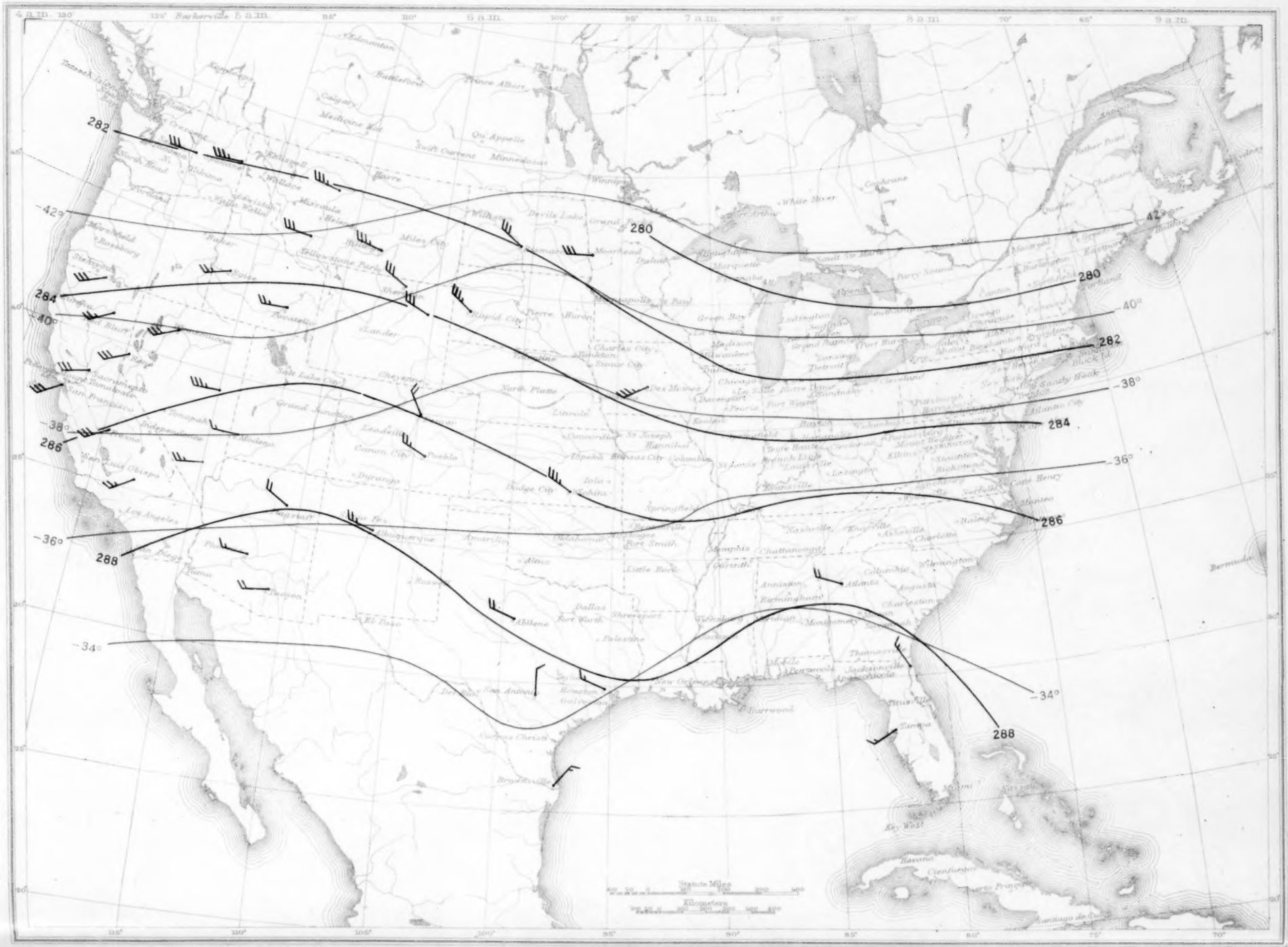


Chart XII. Mean Isentropic Chart, August 1940 (Potential Temperature 314° A.)

Chart XII. Mean Isentropic Chart, August 1940 (Potential Temperature 314° A.)

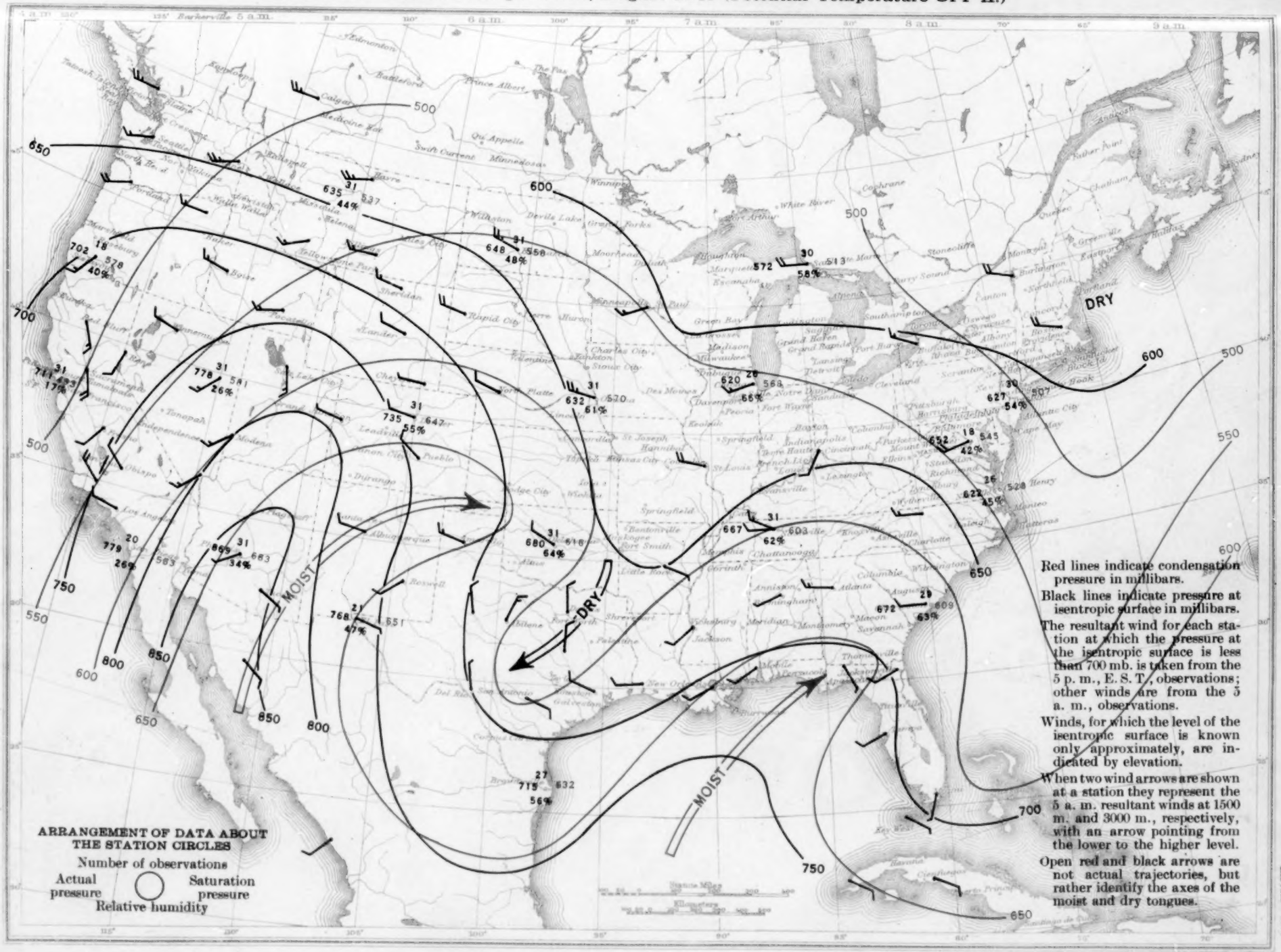
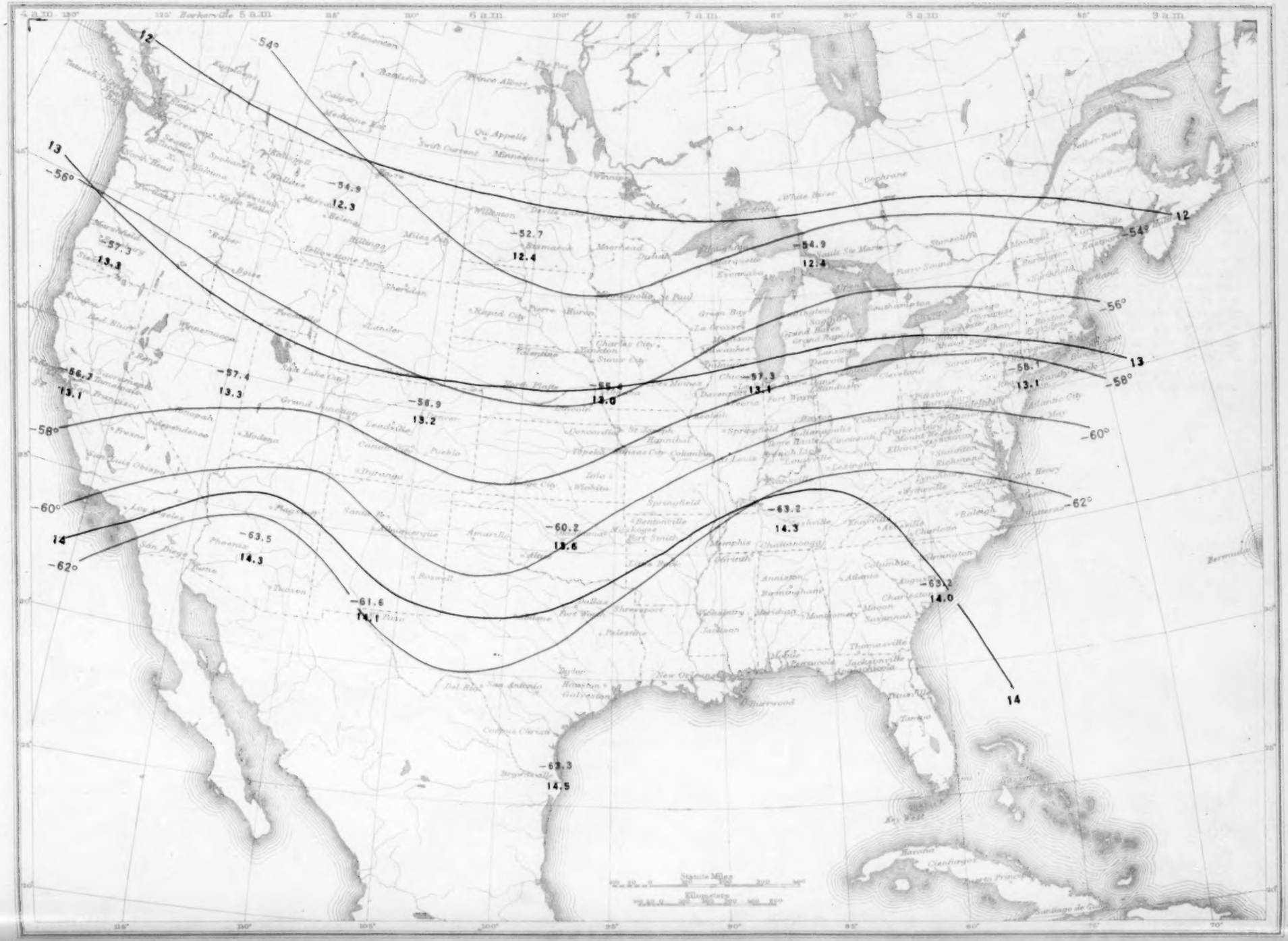

ARRANGEMENT OF DATA ABOUT THE STATION CIRCLES
Number of observations
Actual pressure
Saturation pressure
Relative humidity
MOIST
DRY
MOIST
DRY
Red lines indicate condensation pressure in millibars.
Black lines indicate pressure at isentropic surface in millibars.
The resultant wind for each station at which the pressure at the isentropic surface is less than 700 mb. is taken from the 5 p. m., E. S. T., observations; other winds are from the 5 a. m., observations.
Winds, for which the level of the isentropic surface is known only approximately, are indicated by elevation.
When two wind arrows are shown at a station they represent the 5 a. m. resultant winds at 1500 m. and 3000 m., respectively, with an arrow pointing from the lower to the higher level.
Open red and black arrows are not actual trajectories, but rather identify the axes of the moist and dry tongues.

Chart XIII. Mean Tropopause Data, Altitude (km.) (m. s. l.) Temperature (°C.) August 1940

(Data from table 4)